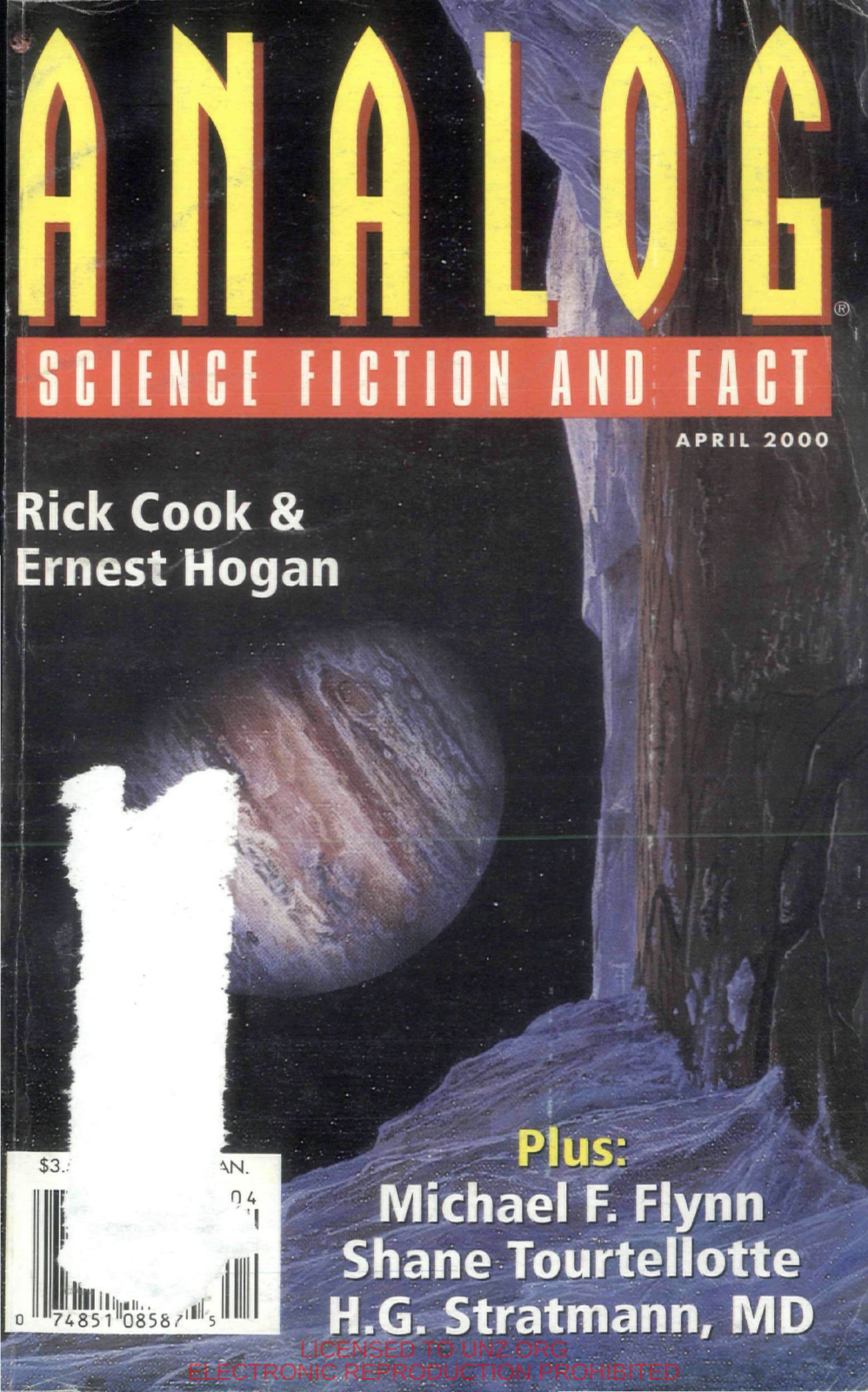

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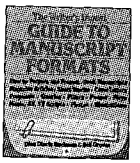

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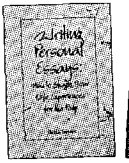

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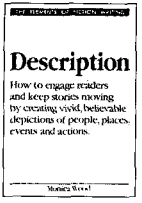
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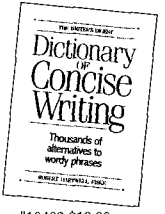

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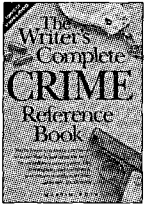

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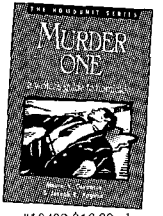

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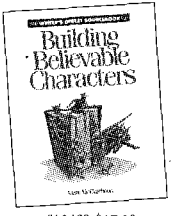

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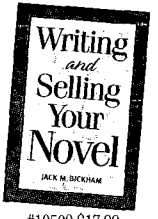

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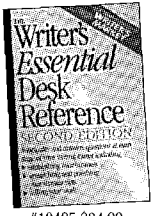

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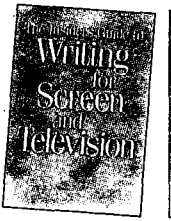

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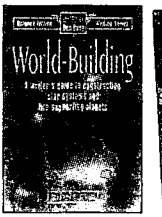

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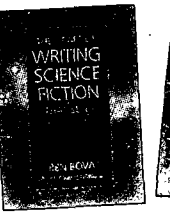

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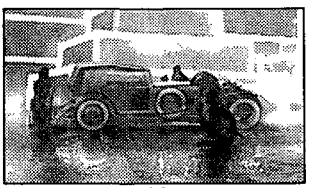

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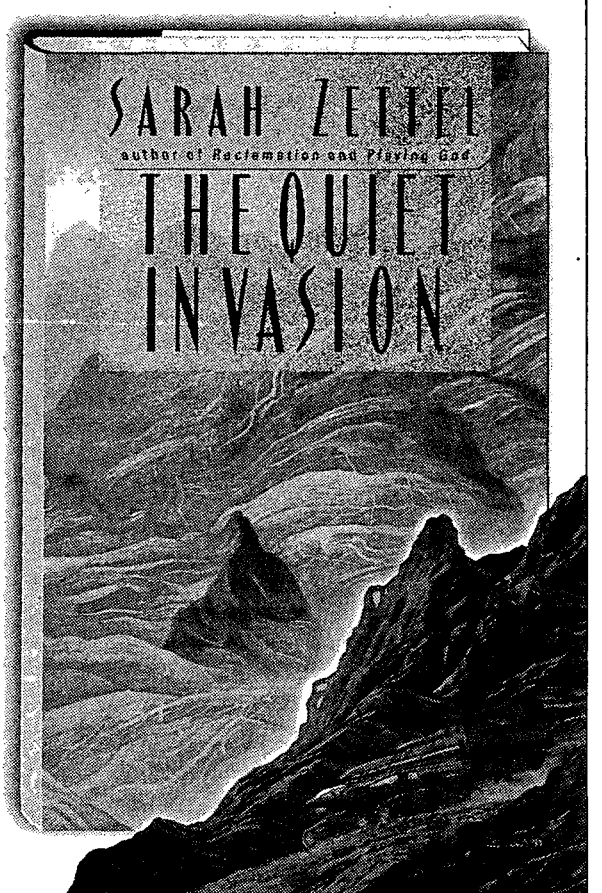

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THE EFFICIENCY TRAP

How can efficiency be a trap? Whatever you want to do, isn't it best to do it with as little expenditure of time and effort as possible?

Well, yes—*if* what you want to do is what you *should* want to do, and what you will still want to have done once you've done it.

That's how the ability to do things very quickly and easily can become a trap. There are at least two common reasons why actions taken quickly and easily can turn out, with even a little hindsight, to have been mistakes. Anything that makes it easy to do Good Things fast and effortlessly makes it just as easy to make mistakes—including big ones—fast and effortlessly.

And the trap is currently being baited with some very attractive morsels.

Consider, just for one example, the "Oxygen Project" described in a cluster of articles in the August 1999 *Scientific American*. This is a cooperative research project being done at the Laboratory for Computer Science at the Massachusetts Institute of Technology. Its goal is to create a (near) future environment in which virtually everyone in the world is connected to a worldwide computing and communications network, using highly portable, voice-controlled, multipurpose units to enable them to "do more by doing less" and to cooperate easily in all kinds of ways regardless of where they happen to be located. In at least some respects, it's truly an admirable and desirable ambition.

The first article in the series describes an example of what the Oxygen system might do. A worker in France finds a potential site for a new French office for her company and uses her handheld electronic factotum (the "Handy 21") to call her boss somewhere in New York. He in turn uses Oxygen to contact three other employees: one at home, one jogging, and one driving between cities. The five of them confer in cyberspace, accessing various reference materials as needed, and in less than six hours decide to commit the company to the new office.

And, we hope, they all live happily ever after.

But do they? Or do they find later that the site lies on unstable ground unfit for building, or that while they were doing all this another employee was pursuing the early stages of a deal for a competing and better site and that dropping those negotiations will seriously harm their company's relationship with one of its best customers?

Personally, I'm more than a little uncomfortable with the idea of making that big a decision that fast. The example in the article specified that the opportunity *had* to be seized within six hours or it would be lost, and I'll grant that such situations can arise. There have been plenty of times when I personally was grateful for the availability of email to do in minutes something that needed to be done quickly and would have taken hours or days to do otherwise. But will the availability of a system like Oxygen lead to a general insistence

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that *most* decisions be made so hastily, with all the risks that entails?

For it does involve risks. One thing that can happen is that people, after a highly variable amount of time, may suddenly see a subtle but important ramification of a problem that simply didn't occur to them right away. Announcing well in advance that your business will move its offices on a certain date may seem like an excellent idea: it will reduce the amount of mail that has to be forwarded from the old address. But if the move is postponed or cancelled and the announcement has been made, mail sent to the new address, where nobody knows you or is prepared to "back-forward" it, may cause even worse problems. Not the sort of thing everybody would think of right off the bat, but if it occurs to *somebody* before the announcement is made, the decision might well be reconsidered.

How many times have *you* awakened in the middle of the night to a sudden awareness of a new angle on a problem that's been bothering you? It happens to me quite often. Sometimes it's a new insight, cooked up by your subconscious, that reveals an easy solution to what had seemed an insurmountable obstacle. Sometimes it's the opposite: a sudden awareness of some remote but horrible consequence of something that seemed like a terrific idea when you first thought of it. Either way, you're likely to be mighty glad you thought of it *before* taking irrevocable action.

Apparently the involvement of several people in the Oxygen example, and their ability to put their heads together over all the relevant materials they can find in their own files and on the internet, is supposed to prevent this sort of thing from occurring. It may well make it less likely; in some ways and in some situations, multiple heads really are better than one. But the fact remains that every one of those heads is still subject to the fundamental *human* limitation of depending in part on subconscious processing, which takes time. Even when a good *team* is working on a problem, with good resources, it's not uncommon for only one of them to think of one of those subtle but crucial considerations, and that one only after appreciable time. If you make decisions without allowing time for that to happen, you are in effect trusting the computer itself to do what your subconscious should do. And while computers may someday be trusted to do that, I don't think we're there, or even close, yet.

The other thing that commonly happens to prove a hasty decision wrong is less subtle: the objective facts may change, or turn out not to be what you thought they were. My wife and I once came very close to replacing one of our two cars because the mechanic's initial diagnosis was that the transmission was shot, and the car was too old for a new or rebuilt transmission to seem a worthwhile investment. We even went so far as to look at replacement cars and tell a

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dealer that we would probably take one, but wanted to mull it over a little longer before we put down a deposit. We were annoyed when he promptly sold it out from under us, but it turned out that he did us a favor. In the meantime the mechanic took a closer look and saw that what had first seemed a serious transmission problem was actually something far simpler and cheaper. We got another year out of that car, but our *other* car *really* had to be replaced less than a month later. We could afford one; two at a time would have been a real burden.

The fact that people commonly have second thoughts or get new information is the very good reason why many jurisdictions have laws allowing a "cooling off" period for at least some types of purchases: a time during which someone who rushed (or was rushed) into a decision can change his or her mind. It's also part of the reason that the U.S. Constitution deliberately makes it slow and difficult to create legislation, and includes in the process both a population-based House of Representatives and a state-based Senate. The process often seems agonizingly clunky and slow, but would it really be better if we took advantage of modern technologies to allow direct and instantaneous popular democracy? Several science fiction stories (perhaps most recently Shane Tourtellotte's "The Virtual Congressional Caucus") have explored the dangers in such possibilities. Too many people are too easily whipped into frenzies of passion, and legislating in the heat of the moment can too easily be disastrous. The constitutional processes that seem to make for absurd inefficiency actually serve the useful purpose of safeguarding against rash decisions—and in the rare cases where speed is really essential, there is provision for emergency executive powers.

I see one other subsidiary but important potential problem in the Oxygen proposal. In the example, I described, two of the employees who were drawn into the decision-making loop were away from the office and apparently not "on duty." Admittedly, with the growing prevalence of telecommuting, the one who was at home might have been doing company work there and reasonably expect to be contacted about it. The one who was jogging, though, might well have been trying to get *away* from that for a while. The disturbing implication in the scenario is that everybody is "on call" all the time, something which Oxygen would make possible but in my

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opinion should never be generally accepted. People *need* some time of their own, when they can reasonably expect *not* to be interrupted to do other people's business.

The Oxygen article explicitly says, in describing the requirements that must be met by the network tying its elements together, "It must find you wherever you are." I can accept that it must have the *ability* to find me wherever I am, *if* I want to be found. But I must be able to turn it off. I insist on having the option of times when I *can't* be found except by people I want to find me—and if you've given any thought to the potential implications of this, I'll bet you will, too.

The lead article on the Oxygen Project identifies five technologies as the basis for the "new world of information": interfacing through speech and other everyday senses, knowledge access, automation, collaboration, and customization. "For the next few decades at least," says author Michael L. Dertouzos, "they are the steering wheel, the gas pedal and the brakes we seek. . . ."

In reading his article and the others that follow, I see plenty about the steering wheel and gas pedal, but little or nothing about brakes. Brakes are important—and when you have a bigger and more powerful engine, which Oxygen or any system like it will provide, good brakes (and good judgment about when to use or not use them) are more important than ever.■

JAMES WHITE, 1928–99

James White, well-known Irish writer and fan, died August 23, 1999, after a severe stroke and more than fifty years of diabetes. Born and raised in Belfast, Northern Ireland, White worked at a variety of jobs in sales, management, and publicity before retiring on disability in 1984. He was best known for his "Sector General" series, though he also wrote a number of standalone novels and short stories.

His appearances in *Astounding/Analog* were relatively few but memorable, including the novelette "Sanctuary," which won the Analytical Laboratory poll with a tale of an extraterrestrial taking asylum in a convent near White's home on the coast of Northern Ireland. In person, Jim was so soft-spoken that it took some effort to hear him, but it was worth close attention for several reasons: the sheer lilt of his voice, his insights and ideas, and his impish sense of humor. He always reminded me of a very tall, very talented leprechaun, and anyone who knew him will surely miss him.

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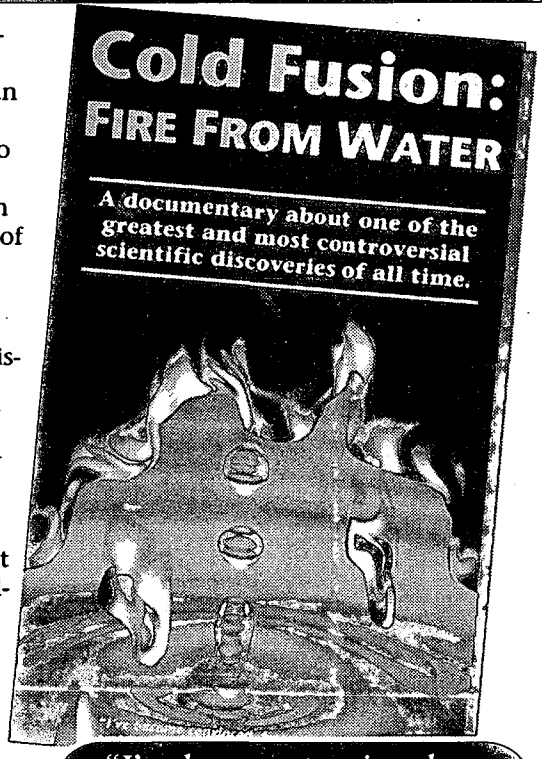
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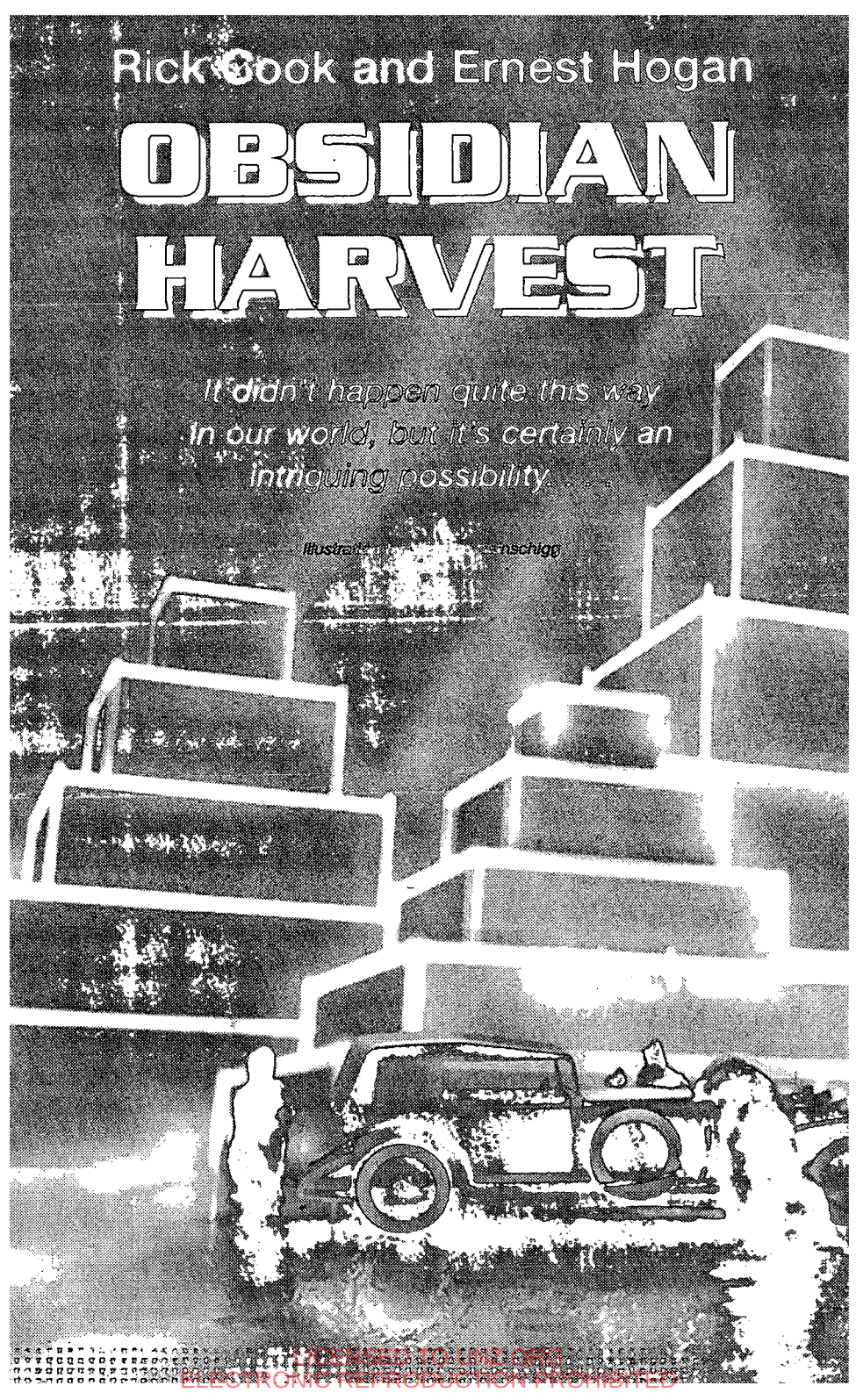
Rick Cook and Ernest Hogan

OBSIDIAN HARVEST

It didn't happen quite this way in our world, but it's certainly an intriguing possibility.

Illustrated by [illegible]nschigg



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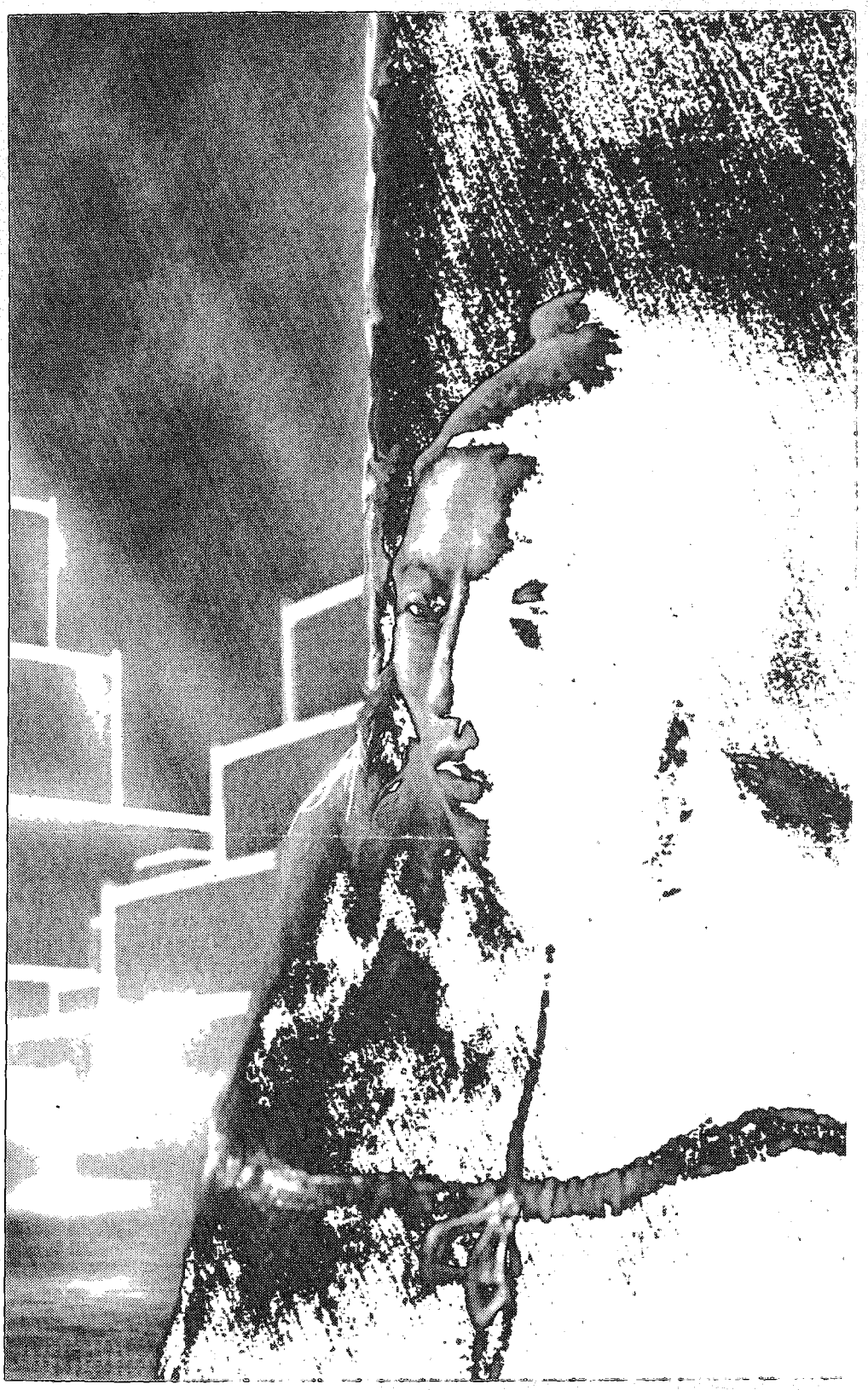

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"I have always liked you, my boy," Uncle Tlaloc rumbled. He smiled at me, showing a row of jade-inlaid teeth.

I nodded politely, sipped my bitter chocolate and listened to my head throb. I wondered what the old bastard had in store for me this time.

Classical music keened and thumped to a crescendo on the main floor of the Hummingbird's Palace as the tone-deaf current object of Uncle Tlaloc's affections belted out the line about the unhappy ending of the romance between Smoking Mountain and White Lady. She didn't even come near the high note. In the old days they skinned singers for performances like that. But times change and the world decays as cycles end; so she smiled, bowed and received enthusiastic applause as she blushed through her yellow skin dye. The combination of the blush and the dye made her look more jaundiced than attractive.

The pungent mixture of tobacco and drug smoke stung my eyes as it blended with the piney-sweet reek of burning copal incense, almost hiding the odors of spices, citrus flowers—and a hint of stale urine creeping in from the privy in back.

Uncle Tlaloc, as fat and ugly as his Rain God namesake, leaned back in his chair, the one with Death carved beneath his right hand and the Earth Monster beneath his left. "In fact I consider you more of a nephew than an employee."

Something bad. Whenever Uncle went into that almost-a-relative routine it meant he had something especially nasty in store for me.

He signaled the kneeling pulque girl, and she glided forward to refill his cup. Her eardrums had been pierced so she could not hear, but he kept silent until she had withdrawn, as noiselessly as she had come.

He glanced around conspiratorially and leaned forward toward where I knelt at his feet, took a hefty swig of pulque out of the skull he used for a chalice and belched malodorously. "I have a small task for you."

"I am yours to command, Lord Uncle."

"Your cousin, Ninedeer . . ."

About as bad as it can fucking get!

"I know him, Uncle-tzin." My voice betrayed nothing.

"He is an acolyte of the Death Master, I believe."

"So I have heard."

"The Death Master has—something—in his temple. I would like to know how it came to die and whatever else your cousin might know about it."

"Am I permitted to know what this thing is, Uncle-tzin?"

Uncle Tlaloc paused, as if considering whether to tell me, and leaned even closer.

"It is a huetlacoatl. An important one."

It was raining when I stepped out of the Hummingbird's Palace, a soft, warm drizzle that felt like Tlaloc Himself was pissing on me. Just like his whoreson namesake inside. I pulled my cloak tighter around me, fingering the single row of featherwork at the neck of my cape. Hummingbird feathers, the mark of a warrior; of the war god, Left-Handed Hummingbird Himself, and hence an inalienable symbol of nobility. Of course, the greater nobles supplemented hummingbird feathers with the plumes of the quetzal, symbol of Lord Quetzalcoatl; but it had been a while since I had any dealings with the nobility, minor or otherwise.

It had been a good deal longer since I had dealt with any of my clansmen. My relatives and I would much rather it stayed that way. But Uncle Tlaloc commanded, and his word was the closest thing there was to law down in English Town. I stepped over a sleeping beggar on the sidewalk, threw back my head, squared my shoulders, and marched off toward the Death Master's temple—every inch a Child of the Hummingbird on his way to his destiny on the Field of Flowers.

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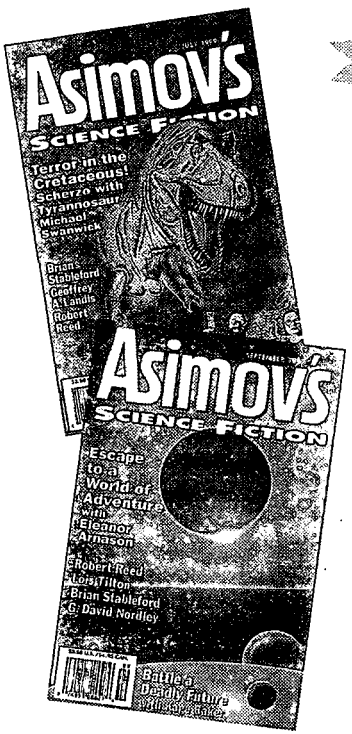

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The guards at the Temple Precinct passed me on the strength of my cloak, the clan tattoo on my cheeks—and my bearing. None of Uncle's other employees could have entered the sacred quarter of the Atlnahuac so easily, which was why the old bastard had chosen me for this job.

The Death Master's temple was at the far end of the sacred quarter, close to the bay and downwind of the major temples. I strolled easily and unremarked among the other nobles, priests, and servants who were out at this hour. Floodlights cast the painted and carved friezes in garish light. Here and there neon tubes outlined the temples on top of the pyramids in reds, the color of fresh blood, and purples, the shade of clotted blood. It was different—harsher—than I remembered, and yet I knew the sacred quarter hadn't changed.

Ninedeer hadn't changed either. He was as thin and gangly as I remembered him. Adulthood hadn't cured his weak chin, and the elaborate jade lip plug he affected only heightened the deficiency. We had never particularly liked each other.

"I didn't expect to ever see you again," he said when a temple servant ushered me into his presence.

I cast an arm at the stone tables behind him and the draped burdens a few of them bore. "Working here? Surely I would have thought you'd expect me to turn up sooner or later."

The years had done as much to improve his sense of humor as they had to improve his jawline. "I didn't expect to see you alive," he amended. "You're not even supposed to be here."

I smiled in the way I had learned since I had been with Uncle Tlaloc. "You could call the guards and have me sent away," I said mildly. "Of course, then I would have to seek you elsewhere to conduct our business."

His expression told me that rumors about what had happened to the last relative who crossed me had leaked into clan gossip. "What do you want?" he asked sullenly.

"I want a look at one of your charges," I said. "And I want to know what you can tell me about it."

"It? You mean an animal?" That was possible, of course. The Death Master's duties included collecting the bodies of animals who had died in the city, as well as dead humans, sacrificial victims, and executed criminals. But he knew damn well it wasn't any animal, and his voice showed it.

"I mean the huetlacoatl."

Ninedeer flinched as if I had slapped him. "No! Absolutely not."

I leaned against the wall in an attitude of exaggerated ease. "One way or another, cousin. One way or another."

He hesitated, weighed his alternatives, and decided it would be better to give me what I wanted now. He shrugged, gestured, and led me down a short corridor. The room at the end was narrow and low, but cleaner than the main receiving chamber. There were sweet herbs strewn on the floor and the gas torches gave a steady, bright light. Normally a room like this would be used to receive the bodies of high nobles and other important functionaries. What lay on the table now was not a noble, and perhaps not a functionary, but it was clearly important.

"Make it quick," he said as we entered the chamber. "They are coming for the body soon."

I gestured and Ninedeer flung back the red cotton sheet that draped the corpse.

The thing on the slab was man-sized and had walked on two legs. Beyond that there was little enough resemblance to a human. The skin was greenish-gray, shading to fishbelly white between the legs. The head had a prominent muzzle filled with sharp teeth made for tearing. The huge middle claw on each foot was drawn back in the rigor of death. The hands were more delicate and supple, but were frozen in a raking gesture. The

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corpse lay half on its side because its tail would not let it lie on its back.

Huetlacoatl, the old Serpent Lords, mysterious inhabitants of Viru, the continent to the south. In spite of hundreds of years of trading, raiding, and occasional open warfare, and in spite of the fact that they had a trading post on an island in the bay, I had never seen one in the flesh before.

"Satisfied?" Ninedeer demanded and made to re-cover the body.

I frowned and gestured him away. The corpse was split from the crotch almost to the neck. There were other wounds on the body, stab wounds to the upper chest showing how the creature had died, and a dark line around the neck that I took to be the bruise left by a garrotte.

I pointed to the gaping wound and cocked my eye at Ninedeer. "It was done after he was dead," he admitted. "At least if the thing works like a human being or an animal. The heart—or whatever kept its soul—had stopped pumping."

"Is the heart still there?"

"Quetzalcoatl, yes!" Ninedeer exclaimed, wide-eyed. "As least as best the Death Master can tell. This one wasn't sacrificed, if that's your meaning."

I bent down to examine one of the three-fingered hands with its raking talons. "Any blood?"

"No. Nor on the big claw on the foot, either. Now will you please get out of here?"

"Shortly. Now what else can you tell me?"

"Nothing. Go away." I didn't need to be a spirit reader to follow his thoughts. As a lesser noble and scion of a Reed clan, I had every right to be here. But my clan membership, and my life, were the only things they had not taken from me when they cast me out. And in spite of a clansman's theoretical rights, I doubted the authorities would appreciate even a clansman in good standing poking around something as sensitive as a dead huetlacoatl. If I were found here they might not spare my life this time. But whatever they did to me, Ninedeer would be in trouble, and that was all he cared about.

Since Ninedeer put more value on his record than I did on my life, the rest was easy. "I've got all night, you know."

Ninedeer ground his teeth. "It was done where it was found, in the alley. At least if these things bleed the way animals do."

That made sense. A deserted alley was as good as any other place for such butchery. I reached down and examined the hem of the thing's drab cotton cloak. "What's this?"

He shifted from one foot to the other. "I don't know. Honestly, I don't."

I held the hem to my nose and sniffed, trying to drown out the snake stink. "Candle grease." I dropped it and looked the body over. Whoever had done this had stood over the thing for a while.

Ninedeer was almost dancing with impatience. "The Speakers to the Huetlacoatl will be here any minute to retrieve the body. If they find you here it will be hard on both of us."

"No sweet herbs and winding sheet?"

"We do not know what the huetlacoatls' customs are on these things. Now *go!*"

There wasn't much else to learn there, so I went. I stood in the shadows across from the Death Master's temple for a while, under a carved Earth Monster that protected me from most of the rain, while I thought about what my cousin had told me. I wasn't ready to return to the Hummingbird's Palace. Uncle Tlaloc likes complete reports, not mysteries.

The first mystery was how the thing had died. A fight among the huetlacoatl? Possibly. They were supposed to kill by disemboweling with the ripping claws on their feet, but the wound had been made from the bottom up, not the top down. What's more, the flesh was sliced neatly, not torn as by a claw. And the marks of the garrotte and the stab

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wounds to the chest suggested human assistance, at least.

Not for the first time I wondered what Uncle Tlaloc was doing sticking his nose in this business. That in itself suggested human involvement.

So, assume the huetlacoatl had been killed by men. It had taken several of them, one to hold it by the garrotte around its neck and more to stab it—probably two more, at least, judging from the stab wounds.

Then why had humans gone to all that trouble to kill a huetlacoatl? True, they were unpopular—so unpopular they seldom left their treaty island in the bay and almost always traveled with an escort of human guards. Yet, there was neither sign nor mention of any guards. Was this one out on privy business?

The swish of rubber tires on rain-slick pavement made me step back further into the shadows. A land steamer, long, low, and as black as the polished jet in Lady Death's necklace, pulled up to the entrance to Death Master's temple. Steam hissed from the beneath the hood as the door swung open. A door too wide and low. Four heavily cloaked and hooded figures emerged silently; the first three as a group, followed after a moment by the fourth.

The three were human, in spite of their elaborate guise and stiff-legged walk. The fourth was not. It was fluid where the others were stiff, strutting where they were jerky, and completely natural where they were studied. It leaned forward and picked its feet high under the muffling cloak. The portal to the temple swung open and the four vanished silently inside.

So. Whatever this was, it was important enough to bring out a huetlacoatl in addition to the Speakers. I knew virtually nothing about huetlacoatl clans, but I did know they weren't noted for family feeling. Clearly it wasn't sentiment that had brought this one along with its human servants. This was looking more and more interesting.

Within minutes the portal opened again and the cloaked figures emerged, a human in the lead, then Lord Huetlacoatl; and then the others, carrying a wrapped bundle between them. The huetlacoatl entered the land steamer first, followed by the burden bearers and the third man. As the door silently closed, the land steamer belched once and then swished off into the night.

I turned and headed back toward the dock area, but not to the Hummingbird's Palace. The night was young enough. The storm clouds were clearing to reveal the dull, starless night sky over the blackened waters of the bay. The colossal statue of the Storm Goddess on the quay smiled at me with chipped teeth and weathered lips. The city of Atlnahuac provided other avenues to explore.

The Serpent's Court was no Hummingbird's Palace. It was garishly modern where the Palace was determinedly antique. Tinny modern music coming out of a beat-up horned machine grated the nerves and set the mood. Its clientele was way down the scale as well, but Uncle Tlaloc's word carried weight here and some of the clients might prove useful.

I paused in the entrance alcove and shook the rain off my hat as the blast of the air conditioning chilled me in my rain-soaked cloak. I scanned the room for a useful face.

There weren't many possibilities. The watchmen from the evening shift had finished their drinks and had gone home long ago, and the night shift would not end until dawn. The other patrons, criminals, whores, and hangers-on, couldn't help me. The only one who looked likely was Sevenrain, sitting by himself in the corner. Not my first choice, but he would do.

Sevenrain was well into his fourth decade, with lines on his face, scars cutting through the tattoos on his arms and chest, and the burly, slightly bloated build of a man who likes corn beer too

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much and exercise too little. A sneer formed on his face as I crossed the room.

"Well, young lordling," he said just a little too loudly as I approached. "You honor us with your presence."

I gave it back to him with a condescending nod. "The honor is mine entirely, oh estimable hound of men," I lisped in a parody of a noble accent. "Allow me a small token of my appreciation by purchasing your next pot of beer."

He glared at me as I sat down next to him, trying to decide if the game was worth continuing. He apparently remembered what had happened the last time he had pursued it—or who I still worked for—and decided it wasn't.

"What in the Nine Hells do you want?" he growled.

"Just a few minutes conversation, and perhaps a chance to show my gratitude afterwards." Sevenrain knew damn well whose gratitude might be shown; and so, probably, did everyone else in the bar who was at all interested. But better not to mention such things.

I shifted my stool so no one else could see my lips move. "There was a killing today down in the warehouse district."

"Quetzalcoatl's dick! Do you expect me to remember every miserable person who gets his throat slit in my precinct?"

"I didn't say it was a person." I said softly.

His face froze. "Yeah," he mumbled. "There was one of those."

"Where exactly?"

His eyes darted left and right, but his lips hardly moved at all. "Behind the warehouses off the English Docks. Between the third and fourth one."

"Time?"

"Found it an hour before dawn. Not one of our people, a sailor looking for a place to puke." His face split in a mirthless grin. "Puked his fucking guts out when he saw."

"Any leads?"

A longer pause this time. "No. No one saw anything. No one heard anything. Nothing at the scene but that—and a big puddle of sailor puke."

I nodded. "You'll send word if you learn anything more?"

"I'll see it reaches the right ears." Meaning he wasn't going to take a chance on me cutting him out of Uncle's generosity.

I nodded and rose, flipping a coin down onto the table so that the silver rang loudly on the stone top. "For your refreshment, my good man," I lisped and swaggered out to the metaphorical sound of grinding teeth behind me.

The night was heavy with the Storm Goddess' moist, salty breath. I could feel more than the usual number of disease spirits floating in the air. My sweat soaked my bed. I threw off the blanket. Sleep was impossible on nights like this.

My eyes caught something. I strained to see it in the darkness. There was a figure at the door, walking toward the foot of my bed.

I wanted to run. I wanted to reach for the sword by my pillow. But I couldn't move. I couldn't even breathe.

The figure knelt at the foot of my bed. It picked up the box I kept there. When it opened the box, a cold, green light was released that lit up its skinless face.

Skinless, not fleshless. The eyes, muscles, and other meat of the body were still present. It was a flayed man. Of course, there was only one flayed man of great significance in my life.

I looked into the lidless eyes, and recognized them. The color of watery chocolate.

"Smoke?"

I couldn't tell if he was smiling. He didn't have lips.

"I've come to visit my skin," he said. "A night like this can be cold to one without skin."

"How sweet."

His teeth glistened in the green light. "I also came to remind you that your life grew in my death as corn grows in the death of the Corn God."

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"My life. How marvelous."

"And to remind you that you could be the one who walks at night without his skin."

He snapped the box shut. The light was gone. I was alone.

Shaking, I crawled to the foot of the bed. I could barely see in the moonlight from the window, but I could feel that the layer of grime on the box had not been disturbed. No one had touched the box. Smoke was not here. It was a dream.

I had only looked into the box at Smoke's skin once, when Uncle Tlaloc gave it to me after he had saved what was left of my life. I haven't been able to make myself open it and look at the dried and neatly folded, tattooed skin since.

"The thing you desire most," Uncle had said when he presented me the box with his own hands. And he was right—then. Then I desired nothing more than Smoke's slow, painful death for leading me into shame and abandoning me to save himself. But like most of Uncle Tlaloc's gifts, this one had two edges, and a point keener than obsidian. By killing my enemy in such a fashion, he cut me off from any possibility of return to my former life. By presenting the skin to me, he tied me inexorably to the deed. And he reminded me, oh so subtly, who held the power of life and death in English Town.

Smoke did not return that night, but my dreams were uneasy and peopled with things I would rather forget. I awoke bolt upright, clutching a dagger before I realized that someone had nudged the foot of my bed. It was my man, Uo, standing over me, impassive despite the knife in my hand. "One to see you," he said as soon as he was sure I was awake.

"Who?"

He shrugged. "She is veiled."

"Weapons?"

His flat peasant face didn't change expression. "A high-born lady."

My visitor was standing in the middle of my front room, arms at her sides and rigid, as if to touch anything was to contaminate herself. Her mantle bore a single conservative row of embroidery which proclaimed her status without specifying her clan.

"My Lady."

She turned to face me, cotton mantle still over her head. Her eyes were large and dark, but not crossed enough to be truly beautiful. Like the eyes of another woman, from a long time ago. The memory grabbed at my gut with chilled talons.

"Are we alone?" she asked when my servant had withdrawn. I nodded and she dropped her mantle, showing her face.

She was handsome without being beautiful. Her skull was not flattened in the Frog fashion. Her hair was lustrous, her lip plug small like the jade spools in her ears. On her chin were the four lines of a high-class married lady. It took me a second to put the picture together and recognize her.

"Well, at least you are not drunk," she remarked.

"Threeflower?"

"*Lady* Threeflower." Her voice was hard and cold. She would not unbend an inch.

"And how may I serve the gracious lady?"

Her eyes flashed. Once, in another life, she was the elder sister of the one I was supposed to marry. Now what was she?

"Ninedeer told of meeting you."

"I am not surprised my cousin could not keep the news to himself. But was that enough to bring you running to me?"

She snorted. "Let us say he reminded me of your existence." She stressed the last word as if I were actually dead. Which, I suppose I was, from her viewpoint.

"Then what brings you to English Town?"

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"A relative. Fourflower."

Oh ho. A gambling debt perhaps, and Threeflower using our past connection to charm her way out of it? That didn't seem right. "I do not know the lady."

"She was hardly a child when you left." Again that emphasis.

By now I was sick of her attitude, sick of the things she represented, and sick of the skinless face of Smoke floating in my mind. I softened my voice. "My Lady, you obviously want something. Will insulting me help you to gain your end?"

A pause. "You are correct," she said, suddenly coldly gracious. "I am trying to *find* Fourflower. She disappeared three days ago, seemingly kidnapped at the Forest Market."

"Seemingly?"

"Her maid heard a muffled scream, and when she turned her mistress was gone."

I cocked an eyebrow at her and she flushed. "The maid was questioned very thoroughly. She held to her story to the end."

"Then Fourflower probably has been kidnapped."

Lady Threeflower glared at me. "I wish her return."

"Then I would suggest contacting a go-between. I can give you a name . . ."

"The go-betweens say they know nothing of the matter," she cut in.

That stopped me. Kidnapping was an old, if not honorable, profession, and one of the reasons the nobles kept their women and children close. But there was an order to these things, a procedure. And that called for the approach to be made through a go-between.

"Three days, you said?"

"Mid-morning on the day of the Ocelot last." Plenty of time for a go-between to contact the family.

Mentally I ran down the list of possibilities. The most obvious one was that the snatch team had bungled the job and the girl was dead. Or perhaps this was an unusually complicated bit of business. Someone had dropped the ball, or the girl's other relatives had been contacted and were keeping it quiet. Too many things could have happened.

"Was Fourflower important?"

"She was of the line of the Emperor Montezuma Himself."

Which was a polite way of saying she was very well-born and had nothing else. No position, no title of her own, no fortune, and no prospects. A cousin-companion to Threeflower, perhaps chosen for her name, and ranking little higher than a servant. But a young noblewoman could become attached to such a one. Especially if her blood sister was a beautiful, faithless, empty-headed ninny. I broke that train of thought off sharply.

"Then there is more to this than you think. Best you go home and await word."

"I want her found!"

"Do you think I can snap my fingers and conjure her here for you?"

"I think you can contact your friends who kidnap."

"They are my associates, not my friends, and they only kidnap for ransom." A thought came. "Was Fourflower pretty?"

"Very," she snapped, and the color drained from her cheeks as she caught the implication. "I suppose you know brothel keepers as well," she said with cold fury.

"Many of them," I said and smiled at her discomfiture. "But none of the ones I know would be foolish enough to kidnap a high-born maid off the streets in broad daylight." *Not unless they were very well paid,* I thought, *and well enough protected not to fear Uncle Tlaloc and his peers.* But word of something that big should have gotten around. This was beginning to sound interesting.

"Did she have lovers?"

"She was untouched," Threeflower said. "The maid confirmed that before she died."

"A flirtation, then?"

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"I would have known even that."

"So." I was silent for a long time.

"I will pay well for Fourflower's safe return," Threeflower said.

"Undoubtedly, Lady. But I will be honest with you. I doubt very much the child is still alive."

"Then I will pay for her killers."

If the girl had died in a bungled kidnapping, the head of the ring would gladly give the skins of her killers as a peace offering and pay wergild besides.

"I will see what I can discover."

She nodded, reached beneath her mantle and tossed something at me. I dodged instinctively, and the deerskin pouch hit the floor with the metallic clink.

"That will do for a start, I think."

I kicked the pouch back to the hem of her skirt. "I am not doing this for money," I told her.

She smiled for the first time. "You shall have nothing else of me. My husband cannot restore you and I would not ask it of him even if he could."

"You misread me," I said coldly.

"I read you well enough to know that in an age when things were done properly you would have been killed instead of merely banished."

"And in an age when things were done properly you would be whipped naked from one temple plaza to the next for visiting a man not a relative, unescorted, and at night." I looked at her speculatively. "That could still happen, you know."

She snorted, threw her mantle over her head and stalked out. Uo must have met her at the door because I did not hear it slam as she left. I was already reaching for the tequila.

It was late the next afternoon when I awoke with a pounding head, a foul taste in my mouth, and a sourness in the pit of my stomach that was more than physical. Twice in two days I had had to deal with ghosts from my former life and that was two times too many.

I dressed in a clean tunic and cloak, bolted down a cold tamale that settled in my stomach like a lump of basalt, and hurried out. It was not long until the market gates would close, and there was someone I wanted to see, as much for my own peace of mind as anything else.

The streets about the Fireflower Market were thronged with porters, slaves, housewives, and their maids. Here and there were caged parrots with their mouths open, hanging their wormlike tongues as if they were dying of thirst. A barefoot Frog girl, barely old enough to be married, blocked my way to the entrance. She was holding a baby who had wooden blocks tied to his skull to make it slope like the forehead of a reptile, but she broke off her plea as we were pressed back against the wall to make way for a green-plumed noble and his retinue.

I followed in his convenient wake, being forced to pause only twice, as he stopped to watch the tiny daughter of a featherworker delicately plucking the feathers off of a skewered hummingbird with thin bone tweezers; and then as he paused by the tattooist, who was beating the line that would make a young man's pretty face look as if it were covered with scales. Around us, the busy market was beginning to clear out. A few of the vendors had already shut their stalls, and here and there sweepers were at work. I dove into the maze of twisty lanes between the stalls, checked my bearings once, and pulled up before a narrow doorway hidden by a reed mat which still bore the stained and weary outline of a jaguar.

"Who comes?" A voice croaked as I thrust aside the matting and stepped through the door into the darkness.

"A pilgrim seeking wisdom from Mother Jaguar," I answered. There was a shifting sound behind me, as if someone had just relaxed, and perhaps lowered a weapon.

"Enter then and be welcome," the voice called, stronger this time. I

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stepped through the second doorway, thrust aside a cotton curtain and came face to face with Mother Jaguar.

She was kneeling at a low clay altar table, casting and recasting knucklebones too small for a deer or a pig. "Sit, my son," she said in a voice that was stronger and younger than the one which had greeted me at the door. "What do you seek?"

She didn't look up until I tossed three silver coins onto the table next to the knucklebones. She was ancient, but her eyes were black and sharp as obsidian points in her wrinkled, tattooed face.

"There is a maid named Fourflower, a high-born maid," I began. "It is said she was stolen from the marketplace on the day of the Ocelot, last. Her family seeks her and would be grateful for any aid."

Mother Jaguar nodded. "I have heard this story, but I know nothing of such a maid or such a stealing. Nor do any of my ones in the world of spirits know of such a thing."

"A kidnapping for private reasons then? Perhaps lust?"

Mother Jaguar cast the bones again and shook her head. "I and my spirits know nothing," she repeated.

I nodded. If you paid Mother Jaguar for information, and if she took your money, then she would tell you the truth. Which meant that neither Mother nor any of her kind knew anything about what had happened to Fourflower.

"Thank you for your wisdom," I said and rose to go.

"Your money," Mother Jaguar said.

I tossed a fourth coin on the table. "It is yours. I asked, and you gave of your wisdom. It is not a fault that the answer was other than I hoped." I turned to pass through the curtain.

"Wait," Mother Jaguar said. I turned and she cast the bones, once, twice, and again, while I waited.

"Your maid is not the only one so taken," Mother Jaguar said at last. "There have been several others, all of impeccable lineage, but perhaps not favored by fortune."

"All maids?"

"Some maids, some boys, a few unmarried men and women, perhaps a hand count in all. All in the last two cycles of days."

"Who?"

"No one knows. Nor why." She turned again to her casting and the coins vanished from the altar as if by magic.

Uncle Tlaloc was impassive when I told him what I had found out about the kidnapping that evening.

It was still early and Uncle was drinking maté rather than alcohol. He took a last long pull on the gourd through his golden straw as I finished my report. "Diverting perhaps," he rumbled, "but I fail to see why it should be of concern to us."

I frowned. "There are ransoms, Uncle."

He waved that away. "Assuming they are alive."

"They aren't?"

"The odds are strongly against it. Besides, I understand the Emperor's Shadow has taken an interest in the matter."

I started to ask why, realized it was a stupid question and closed my mouth. Kidnapped humans could be sacrificed, especially ones of little note but of excellent lineage. And, of course, it was treason for anyone other than the Emperor or the Imperial Priests to conduct a human sacrifice, since it implied a relationship to the Gods which was the Emperor's alone. Yes, the Emperor's Shadow would investigate a thing like that. And the Emperor's Shadow was very bad news indeed.

"Uncle, do you think this is somehow related to the matter of the huetlacoatl?"

"It was not sacrificed, you said. Besides the Emperor's Shadow has shown no interest in that matter." He shifted his position on his great chair and sucked the gourd dry noisily. "No, I think for

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now we can consider such a connection unlikely.

"Meanwhile, my boy, I have another job for you. One that might shed some light on—the other matter."

I leaned against the low stone railing with the midafternoon sun behind me and looked down upon the former lords of creation.

Not far away, a howler monkey bellowed and a jaguar cried.

Long ago, the Hero Twins, Quetzalcoatl and Tezcatlipoca, slew the water monster Cipactli. They made the world out of its mangled carcass, and human creation began. Before that, these, or ones like them, had ruled the Earth.

For their evil, lust, and impiety, the Gods had sent fire from the sky, and their rule had ended. Only on the southern continent, hidden behind a veil of storms, did they remain as a warning to men of the power and majesty of the Gods.

Or so the story went. Personally, I thought that if the Gods allowed man to continue, they owed the huetlacoatls an apology.

There were four of them in the pit below me, picking at the mass of greenery in the mangers on the walls. When one of them stretched erect, its head came to within a few feet of the parapet. And these were not the biggest of the huetlacoatls, only two-legged browsers that walked with their bodies nearly horizontal and their tails straight out behind them. One of them lifted its head, with leaves dripping from its jaws, and cocked an incurious eye at me. For an instant, I wondered what the old lords of creation thought of the new. Then it dropped its gaze and went back to the manger.

That was about the closest I'd come to an insight in the course of a long, tedious afternoon at the Imperial Menagerie. Uncle Tlaloc wanted more information, and I'd hoped for something that would give me an idea, anything, about the murder of the huetlacoatl from studying the other creatures of the Viru.

I'd seen big huetlacoatls and bigger ones. Ones that were big and ferocious enough to be demigods, and ones that were ponderous and stupid. Apparently the southern continent was overrun with the things in all sorts of nightmare shapes. But nothing I saw gave me insight.

It was a rare sunny day, and the menagerie was thronged with nobility and their servants. There was even a fair sprinkling of commoners, admitted by "special dispensation"—actually a small bribe to the keepers. The commoners were wearing their feast day best and the nobles the bright mantles appropriate to their stations. The people were far more colorful than the huetlacoatls, and a lot more interesting than tanks of water monsters, and cages of woolly beasts of the distant north.

I forced my attention back to the huetlacoatls below me, but as I turned something flew past my shoulder into the huetlacoatl pit. They shifted and honked nervously. Then a hand of bananas landed close to the first object, a red-and-green mango. I turned to see four or five other people crowding up against the rail, male and female and most dressed in the plain tunics of commoners. They were chanting prayers and throwing fruit into the pit like worshipers at a shrine. Some of them were rocking back and forth with their eyes closed, as if in ecstasy.

Two of the menagerie attendants came running up, shouting at the congregation and waving their staffs of office. They laid into the little group of worshipers with the heavy mahogany sticks, sending them scattering and screaming. One guard struck a young woman across the kidneys. The woman stumbled toward me, and the attendant caught her a glancing blow on the side of the head. The woman tried to run, but the guard was almost on top of her, striking again and again with his stick.

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I waited until she staggered by me and casually shifted my stance. The guard tripped over my foot and went sprawling face-first into the dirt. While he was down, I took the young woman's arm and motioned toward the alley between the pens with my eyes. In spite of the blood running down her cheek she smiled and darted off. I turned my attention to helping the attendant to his feet. By the time he shook off my ministrations, the girl and the others had vanished.

Meanwhile, other attendants had entered the pit and were busy gathering up the offerings. They scurried among the huetlacoatls' huge clawed feet, ducking beneath the great tails to grab the smashed remnants of fruit. The huetlacoatls were still nervous and any second I expected to see an attendant smashed as flat as that first mango.

There was a low whistle over my right shoulder. All four of the beasts below me jerked upright as if on a string. Their heads swivelled toward me and they pushed closer to the wall. Instinctively I took a step back and groped under my cloak for my sword.

"It's all right," someone said. I turned and there was an old man. He was wearing a dirty cloak with the three lines of feathers of the middle nobility and leaning on a heavy, carved stick. "They're just looking for me. Aren't you, my pretties?" At the sound of his voice all the huetlacoatls began to whistle and hiss.

He stumped to the parapet and looked down. The animals pressed against the wall and craned their necks even higher. He leaned out at a dangerous angle and reached down with his stick to scratch the tallest ones on their muzzles. "How are we today?" he crooned. "All healthy and happy?" The smaller ones were making little leaps to try to bring their muzzles within range of his cane.

"Magnificent, aren't they?" he asked without taking his eyes from them. "I'm their mother, you know." He glanced sideways to see if the statement had the desired effect.

"It must have been a difficult labor, Uncle."

He cackled at the thought. All the while the cane tip kept caressing the monsters in the pit.

"I raised them from eggs," he said as he straightened up to the audible disappointment of his "children." "I was the first thing they saw when they hatched and I stayed with them night and day when they were in the nest, fed them chewed-up leaves. When they were older they followed me everywhere. Oh yes, they are my children."

"You know them well? The huetlacoatls, I mean."

His face cracked into an improbable smile. "As well as anyone. I am Foureagle, the keeper of the Emperor's animals."

"What can you tell me about the huetlacoatls?"

"More than you want to know, young one. Or would believe if I told you."

"Would you share your wisdom with me," I made a quick mental judgement, "over a bowl of pulque?"

Again the smile. "Lead on, young sir."

A grog seller had his cart, brightly painted with many portraits of Lady Mayahuel, the inventor of the sacred drink, just outside the gates of the menagerie. I purchased a couple of gourds, received a perfunctory blessing, and Foureagle and I settled in the shade with our backs to the wall. The old man took a long, deep pull, wiped his mouth and sighed lustily.

"Those damn fools," he said, jerking his head to indicate where the fruit-throwers had been. "They don't understand that those beasts can't digest fruit. It makes them sick."

"Is that why they throw it?"

He snorted. "They think they are worshiping them, making offerings to the avatars of their gods. What they're really doing is killing the poor things—if we don't stop them." He took another swig from his gourd. "All this whoring after

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new gods, young sir. No good can come of it."

I nodded gravely, as if the old man had said something profound. "But of the huetlacoatls themselves, what can you tell me of them?"

"Ah," he sighed and took another pull. "They thrive only down on Viru, you know," he said by way of a beginning. "Only there. They do not do well here, just as man does not prosper there."

"The ones here," I gestured to the menagerie behind us, "seem to do well enough."

"Only because we care for them," the old man said. "It took generations for us to learn how to do so. There are many kinds, and each has subtly different needs. That pen the duckbills are in, for example: it would not do for the long-necks, nor the spike-tails. And if you tried to keep the big meat-eaters in there, they'd be out and among the visitors in less than a day-cycle." Another pull on the gourd. "Those meat-eaters can jump."

"Do they share a common language?"

Again the cackle. "The ones here? They are mere beasts. The huetlacoatl version of deer and jaguar. Only the talking huetlacoatls are intelligent in the way of man."

Shit! An afternoon wasted. I had never thought of the huetlacoatls as intelligent in the sense that men are intelligent, but I assumed they were more than beasts.

"They were unknown to us until we reached the southern lands," said Foureagle. "They are big, powerful, and strange, so men try to worship them."

"Do they ever sacrifice them?"

The old man snorted. "Here? To what end? Their blood will not aid our corn, nor can their deaths help keep the balance with our Gods. They are of an older creation, a different order of magic, if you believe in such things."

"So you have never heard of one being sacrificed?"

"On this continent? Never."

"I have heard it said that they carry powerful medicine within them. Valuable medicine."

The old man looked at me sharply. "Who told you such nonsense? Inside a huetlacoatl is nothing but bone, guts, and muscle, just like a deer, or a man. I should know. I have seen the inside of enough of all of them."

"Nothing worth cutting one open for, then?"

Again the sharp look. "I did not say that. There is knowledge to be gained."

A kind of divination? "Knowledge of the future?"

"Shit, no! Knowledge of the huetlacoatls. How they work. And how they are related to us."

"We are relatives?"

"Not close. They are closer to lizards and snakes, and closer yet to crocodiles and birds. But yes, we are related as all animals are related." He sucked his gourd dry and looked at me expectantly.

"Allow me to provide you with another," I said, rising to return to the vendor's cart for fresh gourds of the milky brew.

While the vendor refilled the gourds, I pondered what Foureagle had told me. By the time I returned I had my new line of questions framed and ready.

"It is said," I began when the old man raised his nose from the gourd again, "that a priest can tell the future from the entrails of a deer." *Or a man.* "Could a priest not do the same from the entrails of one of these?"

"It is said that in England men are born with prehensile toes to better grip the earth so that they may not fall off it," he retorted. "Even those who believe such things know that like calls to like. Better to read the entrails of a chicken, unless you wish to know what portends on the southern continent."

"And yet . . ."

"And yet you seek after phantoms," the old man said, pouring the last of his pulque on the ground and levering him-

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self erect. "You treat these things as if they were supernatural, not of this world. They are not, I can assure you. They are of the same world and the same flesh as we are. Older, it is true. Far older, but there is nothing miraculous to be had from them. Now I thank you for your generosity, young sir, but if you will excuse me I will seek a quiet place to piss."

I had just debarked from a water taxi and gone perhaps two streets back toward the Hummingbird's Palace when I realized I was being followed. A single man, far enough back not to be obvious and no apparent threat. I loosened my sword in its scabbard under the cover of adjusting my cloak and continued on without breaking stride.

It could be I was simply being shadowed for some reason, I told myself. After all, no one would risk Uncle Tlaloc's wrath by attacking me while I was about his business. *Yeah, right.*

I made two blocks more when there was a low whistle from behind me and three more men glided out of the darkness. All were stubby, thick-set, and muffled in coarse black cloaks. Gray turbans were tied about their heads and adjusted to hide their faces and painted to look like death-heads.

I turned to face the one to my left, fumbling under my cloak as if for my sword. The man hung back and our eyes locked. I sensed rather than heard his companions rushing me.

At just the proper moment I thrust backward through my cloak and into the body of the man behind. Then I sidestepped, slashed at the man on my right. That made him jump back and left me free to concentrate on the one to my left for just a split second. A quick upward slash and I felt my blade bite flesh and scrape along bone. He grasped his arm and reeled away while I turned to take on the man on my right as he closed in, sword held hilt low for a finishing thrust.

With a single motion, I swept my cloak off and tossed it at his head, sidestepping toward him as I moved. He dodged away from the cloak, but he was still off balance when I stepped in and split his skull.

I turned to put my back to the wall and looked around. The one with the arm wound was pattering off down the street. The one with the split skull was dead and the third man would soon join him. Now he was rolling on the ground and clutching his belly. My follower, the one who had whistled, had disappeared.

I was breathing hard, and my hands were shaking so badly I could hardly resheathe my sword. *Damn! And that was my second-best cloak.* The blood had soaked into the featherwork and there was no way to get it clean. I left it behind as a calling card and, with a final look up and down the streets, hurried off to the Hummingbird's Palace. Uncle Tlaloc doesn't like it when a messenger is late, and it takes more than an attack by three men to deflect his displeasure.

After delivering my report to Uncle Tlaloc, I sat in the bar at the Hummingbird's Palace, sipping snow wine and keeping my back to the wall while I tried to figure out my next move.

Uncle Tlaloc had been much amused and mildly interested by my adventure with the Silver Skulls. I was much less amused and a lot more interested. Obviously, someone wanted me dead even more than usual. Badly enough to hire one of English Town's strong-arm gangs to try to take me out. But who? Who had I seriously annoyed recently? Threeflower? Unlikely. Certainly this wasn't connected to my errand for Uncle Tlaloc.

And anyway I couldn't imagine anyone in English Town setting the Silver Skulls on me. They were the best-known of the muscle gangs, but the local opinion was they were much better at making threats and breaking knees than killing people. Which implied that

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my enemy was someone with more money than knowledge. Which brought me back to Lady Threeflower, but that was ridiculous.

The Emperor's Shadow? Even more ridiculous. If they wanted me dead, I'd be dead. It would be an accident, a fair duel, the work of mysterious unknowns, or perhaps at the hands of the Death Master, but it would not be done by a bunch like the Silver Skulls. A warning from the Emperor's Shadow then? No, that was too paranoid even for English Town.

The one thing I was sure of was that I didn't like all this attention. Not only would I have to watch my back with more than usual care, but I'd probably have to pay wergild to the Silver Skulls for the men I had killed. And I'd have to replace my feathered cloak.

I sipped my wine and thought about my tailor for a while. Certainly a more pleasant subject than the Emperor's Shadow, or the Silver Skulls.

I was wandering the streets through a dark, starless night. Disease spirits floated through the air, brushing by me as they passed.

A dark alley filled with rapid, delicate noise. A blue hummingbird was fighting with a black butterfly. The noise of battle grew louder and louder. I ran away.

Then a rubber ball came bouncing toward me. I was about to hit it with my hip, the way I would try to play the sacred ball game as a boy. The ball suddenly stopped bouncing.

It wasn't a ball anymore. It was Smoke's skinless head.

"Who are you disappointing this time, Lucky?" it asked.

And a voice said, "Lucky, over here!" I knew that voice. All too well.

I found myself in the neighborhood where I grew up, where I am forbidden ever to return.

Turning to look, I saw Twoocelot. She was standing in the doorway of a rotting Frog-style hut. She wore a bride's dress, but her lips were painted black like a prostitute's.

"Lucky, where have you been all these years?" She asked. Her eyes were so much friendlier than her older sister's.

I tried hard to politely look away. "You know. I know. We're not supposed to talk about it."

"Am I so horrible? Do you prefer my sister Threeflower?"

"No."

She stepped close to me. There was something wrong with her face. Her skin hung slack, like a limp mask.

"Why do you look at me like that? Am I so ugly?" She grabbed a handful of the skin hanging from her face, pulled and tore it away. Underneath was her sister, Threeflower.

"You miss the old days, and your old life, don't you?" She sneered. "You wish that you could have been a gentleman, instead of a thug!"

"I am what the Gods made me to be." I turned to go.

"Lucky," her soft voice called. Something about it stopped me in my tracks. I thought my heart was going to explode. Against my will, I looked over my shoulder at Threeflower.

"Are you really? Do the Gods make us, or do we make ourselves?" Her skin rippled, became blotchy and bloated. Flesh-eating worms emerged like long pimples and ate away her face; except for her teeth, which grew long and rearranged themselves until she had the face of a huetlacoatl.

The next day started in the same way as the day before—which is to say late in the afternoon in a fog of leftover alcohol. No visit from Threeflower, of course. I waited until my reflexes were back together, even if my head wasn't, before I ventured out. Between the padded cotton tunic and the light mail shirt over it, a regular tunic over that, and a rain cloak on top of it all, I was seriously overdressed for the wet season, but I still felt better for it.

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I stepped out of my building with all my senses on full alert. The way was thronged. There were overdressed merchants with retinues like nobles, too-well-dressed individuals whose professions weren't immediately apparent but obviously unsavory. There were slaves staggering under burdens, house servants whose tunics clashed with each other and the brightly tiled walls of the houses. On the corner a vendor was hawking fruit juices from a cart. All perfectly normal and all guaranteed to put my nerves on edge this day.

I moved along at a leisurely amble with my stomach going tight every time someone moved past me or I passed the mouth of an alley. I had gone two blocks like this when someone called my name.

"Hsst. Sir Lucky." Beside me was a boy perhaps ten years old wearing a dirty yellow tunic that marked him as someone's not-too-important house servant.

"I know someone who's got something for you," he hissed without moving his lips. His eyes were darting around and his head swivelled from side to side as if looking for eavesdroppers. Obviously he was enjoying this.

I wasn't, so I gave him my best supercilious stare. "Who might that be?"

"Oh, a beautiful lady who misses your company." The line was the standard panderer's come-on but he flashed a sign with the hand hidden between our bodies. The sign of the jaguar.

"Not in the market," I said gruffly. "Go away." I raised my hand as if to strike him and he grinned and vanished into crowd. I resumed my leisurely pace and at the next corner I turned right and headed for the market.

The gates were closed by the time I got there, but Mother Jaguar wasn't hard to find. There is a dive called the Vulture's Rest on the street of third-rate wine shops and fourth-rate brothels that runs along the market wall near where Mother Jaguar has her divining business. As usual, Mother was in a tiny nook in the back, well hidden from the doorway and doubtless close to one of her many bolt holes.

"I found something that might interest you," she said without looking as I slid in across from her.

"Any words of the wise woman are as spring rain on my ears." She cackled and pressed her hand into mine beneath the table. I felt her make the sign for gold.

Without comment I withdrew my hand, and slid out my other hand bearing three gold pieces beneath the table.

Mother's head sank upon her withered breasts and she seemed to drop into sleep, or a trance. I waited as she rocked back and forth and her breathing steadied.

"One of those has been found," she mumbled in her reedy trance voice.

My lips barely moved. "Ransomed?"

"Dead, quite dead," she keened softly. "In the street of warehouses behind the English Docks. A man of most excellent family, of the Watermonster Clan, and most excellent prospects."

Meaning he was well-born, but otherwise unremarkable, and had reached at least middle age without accomplishing anything of note.

"How was he found?" I asked thinking of the huetlacoatl.

"By the smell," Mother Jaguar intoned. "The smell of those who die slowly. His belly had been slit, and days ago."

"Sacrificed?"

"Who knows? Who knows?" Mother Jaguar wailed softly. Then she dropped her voice even lower. "Others came and took him even before the Death Master arrived. Shadows fell and the poor man vanished forever."

"Forever," she repeated even more faintly and pitched forward onto the table, seemingly unconscious.

"Thank you for your wisdom, Mother." I said loudly enough to be overheard. And, rising from the table, I placed three more gold coins upon it.

I was even more nervous when I left the Vulture's Rest than I had been when

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I went in. I didn't have to ask who the shadows were, or who had taken the body, or why the Emperor's Shadow was interested in the death of a very minor noble. The slit belly implied he had been sacrificed.

I thought briefly of Lady Threeflower and what had likely become of her friend. Then I thought in more detail about the effect this was likely to have on my career and longevity. Being interested in anything that involved the Emperor's Shadow was not a positive career move, to say nothing of its possible effect on your lifespan. I suspected the only reason Mother Jaguar had the courage to tell me about it was that the story was all over English Town. I just hoped my interest in the matter wasn't.

I considered my options and the more I thought about them, the more convinced I became that this was a time to spend a quiet evening at home. That wouldn't help me if the Emperor's Shadow came after me, but it was the last place my other enemies would expect to find me at this time of night. Besides, if I decided a sudden retirement to the country was in my best interest, I'd need items that were at home, such as gold and a certain casket that sat near my bed.

Lady Threeflower was waiting for me in my chambers. She kept her mantle over her face but I knew her by her carriage.

"Is there news of Fourflower?" she asked without preamble.

"None, my lady."

"I had heard," she stopped and gathered herself. "I had heard that someone was found today. Someone who had been taken."

"It was not her, Lady. It was a man." I debated telling her how he had been found—or what the implications were for Fourflower.

She sighed deeply, as if a weight had been lifted from her. "There is one other matter," she said. "My lord husband found out about my visit to you. He is extremely angry, and he may seek vengeance on you."

So that was it! "He already has, lady." My smile was one part irony and one part relief.

She cocked an eyebrow. "I take it he was not successful?"

"Let's say he caused me a certain amount of uncertainty, cost me the price of a new cloak, and probably the out-of-pocket cost of a couple of back-alley thugs, but overall it was little enough."

"Nevertheless, I shall repay you," she said, reaching beneath her mantle.

There was something in the way she moved that made me reach out and jerk the mantle from her face. One eye was purple black and nearly swollen shut. There were livid spots on her neck where someone's fingers had dug into her pale flesh.

"I think," I said slowly, "I would rather be recompensed of your lord husband."

Her chin came up and her dark eyes flashed. "You would see me shamed, then. Does it please you? Does it excite you?" With a jerk she loosened the pin at her shoulder and her mantle and dress cascaded to the floor. "Here. Would you like to see all of what my lord husband did to me?"

I averted my eyes but I still had a glimpse of matronly hips and full breasts, the brown nipples crisscrossed with lash marks. There were other lash marks on her flat stomach and down the sides of her thighs. "I'm sorry."

"What is between a man and wife is no business of anyone else, especially not a clanless brigand," she said, stooping to gather her garments. There was a rustle as she replaced them. "You have served me and I have paid you. Now it is at an end between us."

Even if I had my full clan rank Threeflower would have been too proud to accept help.

Besides, I recognized bitterly, she was right. She knew the risk she ran in com-

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ing to me in the first place and so did I. She had been caught and paid the price. It was not my affair.

The tequila pot was empty, so I slept badly that night.

"Ah, Lucky my boy," Uncle Tlaloc rumbled when I showed up at the Hummingbird's Palace the next afternoon. "We have a request for the pleasure of your company." My stomach clinched at the words.

"A high-born lady, I hope." At least he hadn't used the nephew routine, so how bad could it be?

Uncle sighed gustily. "Nothing so romantic, I am afraid. This is from a priest—of sorts." He caught my look. "Oh, not one of your relatives, I can assure you," he said, holding up a flipper-like hand. "At least not one close enough to claim the relationship, but with the way you nobles intermarry, who can say?"

I cocked an eyebrow at my mentor and employer.

"I do not know why," Uncle said. "He simply asked, very politely, to see you." Then he reached out and took a sip from his skull mug. "Life is so charmingly full of surprises, is it not?"

Personally my life had been way too full of surprises recently, and none of them pleasant. But I smiled and took my leave as if Uncle had done me the greatest of favors. The first rule in this game is never let them see you sweat. The second rule is never let them see you bleed.

The Cloud Villas were on the other side of the city, so I took a water taxi for the first part of the trip, and then a cable car up into the hills. Once, a long time ago, the area had been a suburb, a pleasant retreat beyond the city walls for nobles seeking refuge from the heat and insects of summer. Then, as the Empire tightened its grip and clan warfare was sublimated into other channels, the wealthy and noble began to live here year around. Now those seeking a summer refuge used the distant mountains, only a few hours away by steam train. Proximity to the Great Plaza and the invention of air conditioning had drawn the nobles back to their compounds and the wealthy had found it more convenient to live closer to their businesses. So the neighborhood had filled up with smaller houses and less important residents and the big houses had been divided into apartments or put to other uses.

The temple had started life as a nobleman's mansion, or more likely two or three adjacent mansions. It had been knitted together with a glazed brick exterior, brilliant blood red around the bottom and sunburst yellow on top. There was an elaborate frieze about two-thirds of the way up the side and the wall was subtly shaded to represent a stepped pyramid rather than a flat surface. A set of four broad stone steps led up to the recessed space in front of the door, flanked by two life-size carvings. The two muscular servants in feathered cloaks who stood by the oversized carved doors bore no weapons, but they were guards nonetheless.

The place looked like a child's picture of a temple. Awesome and splendid, but overdone. I'd seen worse, such as the Whore's Temple to Tlazolteotl, down in English Town, but this place spoke of dark old gods put to bright new uses in a way I found unsettling.

A temple virgin guided me from the door, down a maze of halls and up a flight of inside stairs to a rooftop pavilion where my host awaited.

Toltectecuhtli was large, paunchy, middle-aged, and as much of a mixture as the temple he presided over. His head was flattened, Frog-fashion, until he looked like a painting on a Frog temple wall rather than a human being. His lip and ears had been pierced for the heavy jade spools the Frogs favored, but the holes were empty. He wore a green-feathered short cloak that covered his shoulders and came within a finger's breadth of being blasphemy against the

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priests of Quetzalcoatl. His tunic was snowy white set off with gold bangles and a stomacher of lizard skin, and a beaten gold pectoral depicting Lord Quetzalcoatl hung from his neck. His eyes were permanently crossed but that didn't add to his beauty. The whole effect combined the barbaric, foreign, and modern in a way that was not in the least laughable. He sat rigid as a statue on a carved stool, staring out over the rooftops at the city and the bay beyond.

Wordlessly he gestured me to a seat on the step below him, and wordlessly I took it. He kept his gaze on the horizon as I kept mine on him. Although he never turned his face toward me I got the feeling he was sizing me up just as carefully as I was sizing up him.

"Tworabbit," he said at last, in a voice as distant as his gaze. The name startled me. It was my natal name and should have been my everyday name, save that it was notoriously unlucky.

"I am called Lucky," I said quietly.

He turned and suddenly focused hard and sharp as a hunting hawk on me. That unblinking crossed stare gave me the feeling he could see all the way inside me to the black nodules of my inmost soul. A nice trick, that stare.

"Do not discard what you are," he said sharply. "For it is what you are in the beginning that determines what you will become in the end."

"If the fates allow."

"Ah yes, fate." He was silent for an instant. "You represent a noble branch of a fine clan," he continued. "Brought low by unfortunate circumstances."

I said nothing. If this one was trying to unsettle me . . . well, I had been played upon by masters.

"I owe you thanks," he said at last. "You helped someone two days ago."

I shrugged. "The attendant was clumsy. He tripped over his own feet."

"Still, thanks are in order. And a seeker of wisdom you have become."

I shrugged. "Anything that turns a profit."

"Don't lie to me," he snapped. "Profit is not what drives you."

"Not entirely," I said as I thought of the small casket beside my bed.

He smiled in a particularly unsettling manner. "Nor revenge either, much as you would like that believed. No, you seek wisdom, albeit you do not do so wisely."

I licked my lips and wondered where this one got his information. "What would be the wise way to seek wisdom?"

"There is no wise way," he said. "Wise ways are for cowards, fools, and those who do not seek to know. Wisdom is found by treading unwise paths."

I wondered if the extreme skull binding had affected his brain somehow. This "priest" appeared more than half mad, but if it was madness it was combined with an unusual force of character.

"The cycle closes, Tworabbit," he said. "Venus will not cross the sun thrice before the Monkey Baktun draws to a close."

"The cycle dies as all things must." It was the first thing that came into my mind.

He made a dismissive gesture. "That it dies is unimportant. How it is reborn is all that matters. For that is in our hands. Each time the cycle turns we have it in our power to recreate the world entire. To bring together the elements that are tearing our world apart and to form them together as a potter forms clay. To temper them in the fires of the end times until the new world emerges whole and unbroken."

"I had thought that was in the hands of the Gods," I said carefully.

"The Gods do not play dice with the world," the priest said sharply. "They show man the path and each cycle they offer him the chance anew to take it. That we do not is our own doing."

This conversation had started off peculiar and it had gotten weirder and weirder. "You wished to see me," I said,

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hoping to force the talk back to a path that made sense.

Again that stare like a cross-eyed hawk. "And I have seen you. The cycle turns, Tworabbit, and neither you nor I can escape our place upon the calendar stone of fate. Now is the time to weld together all the elements so they may be mixed as potter's clay."

This part vaguely reminded me of some of the street-corner priests of the English Quarter. "You mean nobles and commoners?"

"Oh, more than that, Tworabbit. Far more than that. Nobles, commoners, Reeds and Frogs, Englishmen and others, yes, even the huetlacoatl. To create a thing transcending anything the world has ever seen. A new being for a new cycle."

"That would be a thing to be seen," I said as neutrally as I could.

"And it will be seen, Tworabbit, if we all play the parts we are destined to play."

This wasn't just weird anymore. It had started to remind me of those conversations one had with one's age mates at noble parties. Conversations where nothing was stated, no matter how bright the surface, and much was implied: threats, offers, information swapping, all wrapped up in inconsequential talk. Only here I didn't know the language or understand symbolism. Was I being offered something? Was I being threatened? Was I being pumped for information? It was like one of those dreams where Smoke came to talk to me about his skin. Just as bizarre and just as menacing.

"If we are destined to, then we shall play those parts." Not much in the way of snappy repartee, but it was the best I could do without knowing what the hell was going on here.

This time the stare held me even longer, as if Toltectecuhtli tried to pin me to my cushion by the force of his eyes. "See that you play your part well, Tworabbit. Play it well indeed."

"Forgive me, uncle, but I do not know what my part is."

"That is because your part is ignorance, Tworabbit. Cling to that ignorance. Cherish it. Profess it to all who ask. That is your part."

Then he looked back out over the sea and I waited for him to speak again until the temple virgin touched my shoulder to tell me the interview was at an end.

As I left the temple, I paused at the bottom of the stairs. The frieze showed a polyglot of symbols. There was Quetzalcoatl in both his Reed and Frog aspects. There were human forms representing all ranks and stations. There were signs of the zodiac and the glyph for the end of the cycle. And mixed in with it all were stylized huetlacoatls, running, walking, commanding, and lying in repose. Here and there were the conventional symbols for the burden of time, but instead of burdens or the traditional monsters, these glazed brick figures of humans were locked in the embrace of huetlacoatls. There was something vaguely erotic about their posture, and much more that bordered on the obscene.

As I made my way down the street to the cable car stop, I pondered Toltectecuhtli and his religion. New religions weren't anything out of the ordinary, especially here in the south where the Mexica Reeds mixed with the native Frogs and the regime of the priests was not as strict as it was back in the Valley of Anahuac by the shores of the Lakes of Mexico. I had heard vaguely of the Toltec and his followers, but I had classed them as another huetlacoatl-worshiping cult. Wrong. Even though Toltec was definitely concerned with the huetlacoatls, he was not a huetlacoatl worshiper. It was a lot more complex than that and tied in with the coming end of the cycle.

If I had more than my usual share of luck I might live to see the end of the cycle. It was two hand-spans of fingers and a finger away. Not the Great Cycle,

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when the Universe is recreated, but the smallest of the great cycles, the baktun, or 394 and a half English years. Baktun 13, the Grass Baktun. A time when the world, or man's part of it, was traditionally broken apart and remade new. I was no student of religion, much less of ephemeral cults, but I couldn't ever remember one that tied the huetlacoatls to the end of the cycle before.

Every cycle's end brought with it prophecies of doom of one sort of another. In the time of the Emperor Montezuma they had seemed fulfilled when the first English had landed and stirred rebellion among the subject tribes. But the English had succumbed to the Empire's might and when the English came again years later it was the English English, not the Spanish English, and they built English Town as traders rather than conquerors. Eventually Montezuma's successor, Montezuma V, *the* Emperor Montezuma of popular legend, had welded the empire together even more firmly than it had been before the coming of the English.

Aside from that, the end of cycles had passed with only the usual quota of wars, plagues, and rebellions to mark them. Or so they taught in the schools of the nobles. Each time, the new cycle began with the lighting of the sacred fire atop the Grand Pyramid at the Great Plaza on the shores of the Lakes of Mexico. The Emperor was reconfirmed and life continued, largely unchanged from one cycle to the next. Only the unofficial cults changed as the old ones were discredited when the predicted miracles and wonders didn't appear.

Since leaving my old life I found the common folk saw matters differently. To them the end of a cycle marked a profound change, a chance to strike the world's balance anew—and by implication to ease the lot of the commoners.

But only by implication. Even here in the tolerant South, the priests would not countenance a cult that spread unrest or criticized the divinely inspired order of things. Still, was it such an odd notion that the world as we knew was it coming to an end? Was the Empire as strong or the Emperor as vigilant as He had been? Was there more unrest, more muttering in the cities and banditry in the countryside? Was there more injustice and less punishment for it? Was it really such a strange notion that Reeds and Frogs, nobles and commoners, and yes, even huetlacoatls, might somehow be combined into something new and better for the next cycle?

That thought was still with me when I hailed a water taxi to take me back through the increasingly noisome canals to the English Quarter.

Uncle Tlaloc kept me waiting for nearly four hours at the Hummingbird's Palace before he heard my report. Not that there was anything to report, but I didn't want Uncle getting ideas about my meeting with Toltectecuhtli.

When he finally got around to me he heard me out with a bored expression and waved me away without a word, a sign he wasn't pleased. I didn't bother to finish my last drink and headed for home. It was raining again, and I felt as if all three worlds were pissing on me.

The hall was dark when I reached my apartment building. Not terribly unusual. The gas torch at the end was old and cranky and so was the porter who was supposed to see to it. But tonight it struck me wrong. I pressed myself against the wall and drew my sword. Then I sidled down the corridor with my back to the wall, silently testing every door behind me as I went.

They were all securely locked, but mine wasn't. I pressed flatter against the wall beside the door and reached out with my sword to work the latch. The door swung open noiselessly. Which meant something was really wrong. I deliberately left the hinges unoiled.

The apartment was dimly lit by the gas lamp at its lowest setting. I wasn't about to go stumbling about in the semi-

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dark, so I reached over and turned the light full on.

Shit. The apartment was a mess. The cushions had been slit, items pulled off shelves and scattered on the floor, the shelves themselves had been moved. A low table was upended, as if someone had searched the base.

I made straight for the bedroom. Everything there was in disarray, except the box at the foot of the bed. It was sitting just as I had left it—almost.

I'm very particular about that box. It is arranged just so with a hair clasped in the front corner between the lid and the box. Whoever had searched it had gotten it almost right. The box was within a finger-breadth of where I had left it, the angle was almost right. The hair was missing, having fallen out unnoticed when the box was opened.

I turned away, damning myself for keeping such a thing in the first place. Then I realized I hadn't seen my servant Uo, or his body, anywhere. With my sword still drawn, I went looking.

I found him on his pallet by the kitchen fire, alive, amazingly enough. He barely stirred when I kicked him and a brief examination showed he was drugged. From the looks of it there'd be no information to be gotten out of him before morning.

I went back to the front room, turned the table right side up, pulled up one of the least-damaged cushions, and got out the tequila jug. I needed to settle my nerves, but most of all I needed to think.

Whoever did this wasn't a personal enemy. That the skin was still in its box told me that. No, this was business, and obviously that business involved something I was supposed to have. It wasn't the skin and it wasn't money—although my strongbox had been cleaned out. So what was it?

I thought back to the priest's words. That my part in the changing of the cycles was ignorance. That I was to cling to ignorance, profess ignorance and cherish it. *Screw that!* I was sure as hell ignorant, but this kind of ignorance was likely to get me killed. The obvious conclusion for whoever searched my apartment was that I'd been clever about hiding whatever it was. Their next obvious action was to grab me and question me. I doubted very seriously they'd take "I don't know" for an answer—not unless I said it with my dying breath.

By this time the tequila was half gone and so was I. I braced a chair against the door to prevent unwelcome night visitors, kicked Uo again to see if he was any closer to waking, and when he obviously wasn't, I staggered off to bed.

Sleep ended abruptly. I felt the presence of someone's eyes and breath on me. It was not my servant. "Smoke?" I mumbled. There was no answer. A stranger had been in my room, over my bed, like a disease-ridden spirit coming in an open window. I was not in the mood for another nightmare. My spine from neck to tailbone became unnaturally cold. I did not move.

Dawn was breaking. The light of fallen warriors accompanying the Sun on today's arc through the sky filtered in weakly through the mosquito netting. After some intense staring into empty space, my eyes adjusted to the half-light.

Then some of the neighborhood roosters crowed inharmoniously. My nerves were scrambled, but I was wide awake.

Carefully, I let my eye dart about the room. No one was there. Nothing lurking in the corners or shadows.

I felt that *something* was near. It had to be almost touching me.

There is a time-honored method of revenge in which poisonous insects or reptiles are placed inside a person's body through the sorcerer's art. If skill at sorcery is lacking, the cruder method of simply putting a small deadly creature in a person's bed will do. In these times, among those who deal in not-so-flowery

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wars between clans, the later, cruder method is preferred.

My sleep was deep, but restless. I was tangled in my sheet. With a slow, deep breath I tried to relax all my muscles without moving them too much, raised my head, looked with my eyes, felt with the entire surface of my skin.

I saw and felt nothing, and almost breathed a hearty sigh of relief. Then something glinted in light that grew slowly brighter. Something shiny sparkled. It was close to me. Near my face. Close to my heart.

There, precariously balanced on the knot of sheets under my chin was a delicate work of the carver's art that horrified me. It was a butterfly, masterfully carved of black volcanic glass. A real obsidian butterfly, a manifestation of the goddess of nocturnal visions. The Emperor's Shadow, in the tradition of the poet-emperors of old, used this fragile, razor-sharp metaphor as a warning.

Popular knowledge says that if you are careful and take the obsidian butterfly off your body , pick it up and set it aside without breaking it or cutting yourself, you are destined to live. To cut yourself or to break the delicate symbol meant you are doomed.

I remembered how my mother was always telling me to be careful, and how my carelessness finally disappointed her for good. With an agonizing effort, I pulled a hand free of the sheets. The butterfly, teetered, and slipped between a fold of cloth. I carefully reached for it, aiming my fingers at the flat surface of the wings.

"Holy Shit!" I screamed as the edge of one of those black, transparent wings bit into a fingertip. Instinctively, I jerked back my hand. As if alive, the butterfly soared across the room, to shatter into spray of black crystal against the wall.

I sprang from bed, sucked the blood from my finger like a thirsty god, and thought, They may call me Lucky, but there's no question that I was born on the second day of the Rabbit.

* * *

Uncle Tlaloc wasn't drinking when he summoned me into his presence. That was a very bad sign.

As I knelt before him I felt his eyes boring into the back of my head. He didn't bid me to rise and sit as usual. He just kept looking at me like an ocelot looks at a baby bird it can't decide whether to play with or just eat right away.

"I understand there was some excitement at your quarters last night," he said at last.

His face didn't change while I told him the story.

"It sounds as if someone wants something you have," Uncle Tlaloc said mildly.

"So it would seem, Uncle-tzin."

"What?" His voice had the sting of a cracking whip. "What is it they seek?"

"On my grave, Uncle, I do not. . . ."

"What did you take from the huetlacoatl?" he roared. I flinched from the sound.

"Nothing, Uncle. I swear it. Ask Ninedeer, if you do not believe me."

"Others are already asking," Uncle said slowly. "Your cousin Ninedeer was taken yesterday. By the Emperor's Shadow, apparently. It seems His Imperial Majesty has decided to interest himself in the matter of the huetlacoatl's death after all."

I realized I was sweating in spite of the air conditioning. Sweat had already soaked the armpits of my cotton tunic and was starting to trickle down my chest and back. This could probably get worse, but right now I couldn't imagine how.

He looked at me again in a way that wasn't at all settling. "It is not unknown," he said softly, "for someone to try to keep something back if the prize is rich enough."

I remembered what had happened to those people—the ones Uncle Tlaloc had chosen to make an example of—and shuddered. There are worse fates than being slowly flayed alive.

"Uncle-tzin, I swear to you that I hold

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nothing back. On my own grave I swear it."

Uncle was looking at me in a way that indicated that might not just be a metaphor. Then he leaned back, rested one hand on Death and the other on the Earth Monster and smiled in a way that was totally unsettling.

"And I believe you, my boy. You swear you do not have this thing, whatever it is, and of course you would never lie to me."

"Of course not, Uncle," I croaked.

"So the matter is closed," he said with the same terrifying geniality. "But, nephew . . ."

"Yes, Uncle?"

"If you do find this thing, you will tell your old uncle, will you not?"

"Of course, Uncle. Absolutely." He gestured at me and I backed away, still on my knees.

I wandered the streets, examining the gathering clouds and play of light on the waters of the bay. There wasn't any place I was going. There also wasn't anybody I could talk to. People who seem to know anything about this mess keep ending up dead.

On a busy corner an old man with the matted hair of a traditional priest was holding out a limp, obviously drugged, rattlesnake. When he saw me, he practically shoved it in my face.

"For only one small gold coin," he said in a voice that had been destroyed by years of exposure of sacred smokes, "I will let you pet the noble serpent who warns before striking, the brother to the Feathered Serpent who gave us our law and culture. It will bring you good luck."

The snake's face was close to mine. Its mouth opened, and its fangs slipped out of their sheaths. All the while, its tail and rattle hung limp, probably because of the drug.

"I don't know, unwashed one," I replied without slowing down. "Your friend looks like he may make an exception and rattle after he bites me."

"Blasphemer!" The old man screamed as walked away. "The Gods will punish you!"

"I know, I know," I said and turned away.

The problem was, that I didn't know. At least about just what it was that everyone seemed to think I had. I'm an axe, a sweeper, not a sneak-thief. And what is it that I could have slipped under my cloak and smuggled out of the Death Master's, and to my apartment or some secret location? What could be that important? And why would it be on the body of a dead huetlacoatl?

Or maybe it was *in* the body. . . .

The thought was too disgusting to pursue. Besides, the hairs standing on the back of my neck told me that I was being pursued. The old geezer with groggy rattlesnake was still glaring at me. And his weren't the only eyes on me. People on the street looked away when I looked at them, but I could tell that they were aware of me. Every window and corner made me nervous.

I put my hand on the hilt of my sword. Somehow it did not make me feel secure.

Suddenly, I felt the need to flee. There were too many people. I couldn't sort out who—if anybody—I should be looking out for. I walked faster, until I was just short of a run.

I glanced into some deserted alleys. Unfortunately, they were too deserted. Someone could be cornered, killed, left in a pile of garbage, and not be found for days, flayed by the rats and scavengers that feed off corpses.

Then someone grabbed my sword arm. Something else struck the back of my head. Everything went white hot, then dead black.

The sound of conch trumpets filled the air. It was the long, deep tone that announces the approach of a hurricane. Near the English Docks, the great statue of the Storm Goddess looked at me and licked her ragged, stone lips with a

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pink, fleshy tongue. The water withdrew, back toward the southern continent, leaving ships to sink into the muck on the seafloor. I ran toward higher ground.

The city was deserted. The only signs of life were cages containing parrots that had been reduced to skeletons, and the ants that were picking away at the last remaining bits of meat. Was I asleep when the city was evacuated? No one was in the streets. Nothing moved except for the debris that flew about in the winds.

The clouds boiled. There was a rumbling deep in the earth that echoed through my bones and across the sky. The wind grew stronger, making a noise like the mother of all disease spirits.

Then it rained. The things that pelted me and the empty streets were not raindrops, but eggs. When they hit the ground, they cracked open, leaking a steaming purple fluid and revealing the tiny bodies of creatures that looked almost human.

"Earthmonster, devour me!" I screamed.

"Be calm, Lucky." It was Mother Jaguar. "Things will be all right. Look." She held out a polished obsidian mirror.

I looked into it, and saw myself. My skin hung loosely around my face. Grabbing a handful, I tore it away. Underneath I had a huetlacoatl snout.

"Face your destiny, Tworabbit," said Toltectecuhtli, who was suddenly holding the mirror. As I looked into the mirror I was plunged into darkness. Pungent smoke curled up and I coughed at the vile snake scent.

"He wakens," came a voice from far, far away.

Then the world reeled, the hood was yanked from my head, and I was blinking in the light.

My first thought was that this wasn't the doing of Threeflower's husband. Then where I was actually sank in.

The room was low, gloomy, and damp. The gas torches were turned too low for me to see the extent. The furniture was uncomfortably low as well. Uncomfortable for humans, at least. There were three men standing before me and one more crouched down in the background. Correction: There was one more *something* crouched down behind them, but it wasn't human. It was a huetlacoatl, the first intelligent one I had ever seen—alive, that is.

"We want the body," one of the Speakers said abruptly.

"What?"

"The body of the slain one. We want the rest of it. Come. Do not waste the Great One's time. Give it to us." One of the other three had turned to the huetlacoatl and croaked and squeaked at it as if translating. I couldn't see the huetlacoatl well enough to make out its expression and that was probably just as well.

"You have the body," I said.

This was translated and produced a roar from the huetlacoatl.

"All of it," the Speaker cried. "We must have all of it."

"But it wasn't sacrificed. It was all there."

"*Lies!*" the Speaker screamed. "You think you can lie to us because we do not torture like animals. But we will have the truth and we will have the treasures of the line, the rest of the Great One's body."

I thought fast. Ninedeer had said that all the parts of the body were there. They must mean something else, something that was on the body. An insignia of rank perhaps. That made sense in light of Uncle Tlaloc's comment about something being taken from the body. Some priests referred to the sacred objects they wore as part of themselves. And there were stories that the huetlacoatls adorned themselves with rare and costly jewels—as well as less pleasant things. The Speakers were notoriously hard to communicate with, but it made sense.

"Describe this thing to me. The thing

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that was missing from the Great One's body."

The translation produced another roar from the huetlacoatl and I thought the Speaker would explode, the way he turned red and puffed up. "The treasures of the line," he screamed. "The things that make the Great Ones. We must have them now!"

Treasures. Multiple. Then several things had been taken from the body. I tried to remember if there were any spots on the dead one's cloak where something might have been torn off. Or perhaps they had been attached directly to the skin and that was why it had been cut up.

The huetlacoatl spoke for the first time except in response to the translator: a long collection of hisses, squeaks, and squeals that ended with a clash of teeth like a gunshot. All three of the Speakers turned toward the creature and froze in identical postures, one foot in front, bowing forward from the waist and the right fist pressed to the forehead.

"We waste the Great One's time," the Speaker spat as he turned back to me. "If an animal you act, then an animal you shall be treated."

"We are civilized," the Speaker snapped. "We do not offer ourselves in the marketplace for food."

I wondered just what it was the huetlacoatls were trading for—or what they thought they were trading for. "But it is meet that our enemies be hunted in a civilized manner, to expiate their crimes." He gestured to the slaves holding my arms, turned and strode away with me being dragged after him.

"There!" the Speaker gestured over a balcony and down to a courtyard below.

At first I couldn't see anything but a flagged stone yard with a water trough. Then there was a "wheeping" sound from beneath the balcony, and another, and another. Then four huetlacoatls came bounding into the court, wheeping and craning their necks to see what was on the balcony.

There was nothing to give me scale, so it took me a minute to realize these huetlacoatls were smaller than usual. It took me a minute longer to infer from their clumsy movements and their tussling that these were immature huetlacoatls. As a group they were as cute as a nest of baby rattlesnakes. Only I didn't think they had the high ethical standards of rattlesnakes. And I didn't like the way they were looking up at me and wheeping expectantly.

"We tie you by your arms," the Speaker said. "Then we lower you down so the young can practice hunting. Just your feet and ankles and first, then your legs. So you may reconsider your theft from the Great Ones."

Well, at least I'll be able to kick the little bastards' teeth in. Not much comfort, but you take what you can find.

The Speaker leaned close. "Only first we break your legs so you cannot hurt the little Great Ones."

I was digesting this information and trying desperately to come up with a plausible lie when a huetlacoatl whistled so high that it almost hurt. I managed to twist around in the slaves' grip and see that a new group of humans had entered the room

There were six of them, cloaked in gray, with gray hoods drawn over the heads, and gray masks covering their faces. I'd never seen that outfit before, but I knew what it was. It was the closest thing to a uniform ever worn by the Emperor's Shadow.

There was a long palaver between the Speaker and one of the Shadows. I divided my attention between trying to overhear them and listening to the plaintive cries of the young huetlacoatls below me, who obviously weren't used to waiting for their supper. Finally, after an extended, involved discussion, the adult huetlacoatl made a slashing gesture and a steamwhistle bellow. The Speakers bowed and stepped aside, letting the Emperor's Shadow have me. Personally, I would have preferred the huetlacoatls,

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but my wishes didn't count for a whore's fart.

Another hood, another journey, but this time I was awake. I know we walked for a ways, there was a boat ride across the bay, a slower, smellier ride through the city's canals, and then more walking. No one spoke, and the ones who held me never loosened their grip.

This time when the hood came off I was in a low-ceilinged room with stone beneath my feet. There was a single blinding light shining in my eyes. I squinted and tried to twist my head away but the ones behind me forced me to look straight ahead.

"Young sir," came a voice from the darkness, "you must learn to associate with more wholesome companions." He hobbled into the light and I saw it was old Foureagle, the menagerie keeper. "If you consort with those who want to be huetlacoatls, evil will befall you."

"What about the company you keep? What's a tender of caged beasts doing with the Emperor's Shadow?" I remembered his remark about having seen the insides of a lot of people and tried not to show it.

He smiled. "A man is many things. It not only keeps life interesting, but it is necessary in times such as these." I decided I had liked the old man a lot better when we were sucking down pulque outside the menagerie. I also realized I had gone fishing for information on a very sensitive matter by questioning a high officer of the Emperor's Shadow. *Shit!* One thing about my luck. It's consistent.

"But come, young sir, you do not seem pleased to see me."

" I think I'd be better off with the huetlacoatls."

Wrong answer. It made Foureagle frown and earned me a kidney punch from one of the Shadows. I sagged forward, retching.

"These ones with their costumes and silly antics have no idea of what they are doing," Foureagle said. "They've got it all wrong, dead wrong."

"They speak to the huetlacoatls well enough."

Foureagle snorted. "They speak as a dog speaks to its master. They sense emotion well enough but they understand only a little. The rest is deception. They deceive themselves and the huetlacoatls deceive and use them."

"Like you use the beasts in the menagerie?"

"The relationship between man and beast can be understood," he said, his eyes narrowed into slits, "but between man and these thinking, talking *creatures?* Where do we begin to know anything? How can we trust?"

"You understand them."

He shrugged. "I know when they are afraid. Even if their language is mostly a mystery, the prattling of the Speakers is easy to understand. The huetlacoatls are upset and they are driven to the point of hysteria. The thing you took from the body was very important to them." He smiled. "Important enough that the huetlacoatls brought the affair—forcefully—to the attention of the Emperor Himself. You were unwise to upset them so, young sir. If we cannot understand each other, we cannot trade, and the Emperor values the trade with the huetlacoatls very highly."

We were still in the intellectual fencing stage, which meant I would remain whole and functioning for a least another few minutes. What Foureagle said made sense. The huetlacoatls hadn't been really upset until they recovered the body with whatever-it-was missing. Then it took time for the word to reach the capital and for the Emperor to turn his Shadow's interest to this new case. All very logical, but I was damned if I could see how it helped me.

"Uncle, I swear to you I took nothing from the body."

"So Ninedeer maintained," the old man said, as if savoring a memory.

I shook off the sudden chill down my

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spine. "If something was taken, it must have been by someone else. The sailor who found the body, for instance. Or the city guards who investigated it."

A gauntleted fist slammed into my face. I had to cough and hack to clear the blood so I could breathe.

"These possibilities have been explored—thoroughly," Foureagle said. "So we come to you by a process of, ah, 'elimination.'"

"But I took—" This time the blow was from the front and knocked the breath out of me. Somewhere off to one side there was the sudden odor of burning charcoal as someone lit a brazier. I twisted and gasped and knew this was only the bare beginning of what they'd do to me before I died.

Unless . . .

The Speakers kept referring to the missing thing as "part of" the huetlacoatl. The huetlacoatls themselves might have continued that use, but the Speakers would have known enough to employ human usage when questioning a human.

Another blow to the face ended my speculation.

"Uncle," I gasped. "these things, how do they bear their young?"

"Eh?" This wasn't the way he expected the conversation to go. "Why, eggs, of course. Like crocodiles, or birds."

Shit! Another beautiful theory murdered by a gang of ugly facts.

"Although," Foureagle continued slowly, "not all of them lay the eggs in a nest. Some of them, like some snakes, hold the eggs in their bodies until the young hatch." He looked at me sharply. "Like the huetlacoatls."

"And the one who died was female." It wasn't a question. "Toltectecuhtli keeps talking about a great joining of humans, English, and even huetlacoatls. To make that work he's going to need something like the Speakers." The effort made me cough, which hurt my ribs even more. I wondered how many were broken.

"Except they would be huetlacoatls raised among humans rather than the other way around," the old man finished my thought. "Young sir, I believe you have it." He smiled, and I felt the grip on my arms loosen imperceptibly. Then he frowned. "But it is still just a theory, of course. And it does not tell us where the eggs are."

"I think I know," I said slowly. "Uncle, may I beg the boon of a handspan of days to find out?"

Foureagle rubbed his chin. "I will give you one day," he said.

Considering the obvious alternative, I took it.

One thing about being beaten up, it makes disguise easier—if you're disguising yourself as a cripple, that is. And I was. Some artificial scars and pockmarks helped the effect. But the bruises on my face and the swollen eye were real. So were the limping, halting gait and the painful, gasping breath. The ragged tunic was my servant's, but the sword underneath was mine.

The public parts of the temple were easily accessible. There was no service tonight, but a fair number of pilgrims wandered the halls, pausing at small shrines to pray and make offerings. No guards, of course. One would have to be truly mad *or very young and stupid* to profane or steal from a temple, even a temple of such an odd religion.

I hadn't really seen much of the place the last time. It turned out the inside was just as gaudy and probably just as disturbing as the outside. "Probably" because the place was lit by torches rather than gas lamps and much of it was lost in the gloom.

Now if I were a huetlacoatl egg, where would I be?

Someplace secure, of course. Out of the way, yet an important place. A sacred place. Then I remembered the use the Frogs traditionally made of their temples that the Reed folk did not. If this place followed the custom, there would

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be a crypt beneath the structure, a place for the burial of kings. *Or the birthplace of kings.*

The place had probably been a maze to begin with and the group's alterations hadn't improved that any. I drifted along the corridors, stopping at shrines to pay my respects and generally trying to look like I belonged.

Toltectecuhtli came striding down the corridor, resplendent in a headdress of quetzal plumes and beaten gold. He still wore the lizard-skin stomacher and the gold Quetzalcoatl gorget, but his elaborately embroidered kilt was new. From his belt hung a maquahatl, the flat wooden war club fitted with blades of keen obsidian along the edges. With his sloped head he looked like he had stepped out of a temple wall painting.

What the hell? I followed him. He went to the center of ground floor, then down a stairway that was framed by the masterfully sculpted gaping jaws of gigantic huetlacoatls. It reminded me of stories of the underworld, the many Hells beneath the earth. An undistinguished soul on his way to oblivion, or one of the Lords of Death?

Down the stairs it grew dark, and the air became clammy. I heard moaning. Horrible moaning. I shuddered. Could the myths be true?

At the end of the narrow stair was a long corridor, with light showing from a side passage far down and off the right. I pressed myself against the wall and glided toward the light. The dank silence was broken only by an occasional moan.

Toltectecuhtli stood in the middle of a wide chamber lit with many lamps. The light flickered and shifted, making it hard to see things. Which was, perhaps, for the best.

The place was a ghastly parody of the Death Master's laying-out room. Stone tables dotted the room and forms covered with sheets lay on most of them. Toltectecuhtli was bending over one of the tables with his back to the door. He did something, and the thing on the table moaned like one who has been flayed but is not quite dead yet.

As Toltectecuhtli stood up I could see that the person on the table still had her skin, at least from the waist up. The priest strode away from the table to a door in the rear of the room. He unlocked it, passed through, and I heard the lock click as he relocked it from the inside.

I stayed where I was, listening hard. There was no sound through the damp, close air, not even from the tables. But there was a smell: the stink of strong tequila.

I moved carefully into the room and approached the table where Toltectecuhtli had uncovered the woman. She was young, with breasts that were full but had not yet begun to sag. She might have been pretty once, but suffering had drained all the beauty, and most of the humanity, from her.

"Fourflower?" I whispered. She turned drug-dimmed eyes to me. They were like the eyes of a dumb animal. No hope, no pleading.

Then I saw why. There was a gaping red wound from breastbone to groin. The belly skin was pink and healthy with no flush of infection, but the edges of the wound were separated by a handbreadth and the belly was pushed out, as if bloated.

I looked closer and saw there was something in the wound, inside the woman.

It was grayish, rounded, and netted all over like a melon. I didn't have Foureagle's knowledge of human insides, but I knew that this thing didn't belong in a human belly. I shifted to get a better view and saw it was about twice the size of a large goose egg.

Eggs? Then all the fragments fell together. Like a shattered obsidian butterfly reassembling itself and flying away.

There are priest-surgeons, specialists, who can open a man up without killing him to treat a sickness of the body. They use the finest obsidian blades, take the

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greatest care not to cut into the bowels and carefully sew the flesh and skin together after dousing the area with the purest double-distilled tequila. Most of the time the patient even recovers.

Toltectecuhtli wanted a blending of huetlacoatl and human. What better way to blend the two essences than incubating huetlacoatl eggs within human bodies?

There was a crash behind me of something shattering on the stone. I whirled and saw Toltectecuhtli standing in the door I had come through. The remains of a jug at his feet and the stronger smell of tequila told me where he'd been. In the semi-darkness with the lamps hitting him from below he looked like a vengeful wall painting come to life. About a ten-foot-tall wall painting.

"Good evening," I said pleasantly, to distract him while I figured out whether I'd have to take him out or could just run.

If Toltectecuhtli's eyes were crossed, there was nothing wrong with his hearing.

"You do not belong here, Tworabbit."

"I couldn't agree with you more," I said amiably. "So I'll just be going."

"Your part was ignorance! I told you to play your part in the great change."

"Ignorance is an expensive commodity," I said, moving sideways toward the main door. "Too expensive for a lowly person such as me."

He growled in inarticulate fury and leaped to the door, blocking my way out. In a single swirling motion he went for the bladed war club at his belt and launched a furious overhand swipe at my head.

I ducked and barely got my sword up to parry. The force of the blow drove my forearm down onto my forehead and twisted my sword in my grip. But the club went skittering off my sword and missed my body altogether. I tried a fast counterslash to his chest, but the old man twisted away easily and brought his maquahatl up in a disemboweling blow. I parried and gave ground and he came after me swinging left-and-right at my head.

That damn club was heavy, which made it hard to parry, and the obsidian blades set along the edge could open me up as efficiently as any steel sword. In spite of his age this priest was strong as an ox and fast as a teenager. I was neither and I was in a lot of trouble.

I tried to dodge around to his left side, but he spun on his toes before I could complete the move. He aimed another at my head. I raised my sword to parry and with a twist of the wrist he dropped the blow toward my legs. I scrambled back, but the tip raked me across the shins, leaving bright wellings of blood on both legs.

Frantically I dodged around a stone table. He struck at me over it and I flinched back, feeling the air stir as the maquahatl whistled past my face. The person on the table looked at me with dumb, pain-ridden eyes.

As Toltectecuhtli came around the table, I whipped my cloak off and threw it at his face, trying to blind him. While the cloak was still in the air I followed through with a lunging thrust. I missed but his reflexive return stroke didn't—quite. The club came down on the point of my right shoulder and tore an ugly gaping wound that left my whole arm numb.

He saw what he had done to me and started forward in triumph, his club coming up for an overhand blow.

I tossed the sword to my left hand and parried. This time his eyes widened and he stepped back. "Huitzilopochtli," he whispered hoarsely. "Lord Left-Handed Hummingbird."

I don't know what was going on in that god-ridden, madness-fogged brain, but obviously I had triggered something. I pressed the advantage ruthlessly, striking left and right in my turn before he could recover his composure.

He parried, but more clumsily. Madness aside, fighting a left-handed swords-

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man is difficult for a right-hander. You have to do some things backwards and very few nobles ever train in the art because left-handedness is considered unlucky. Uncle Tlaloc's retainers are more practical about such things.

Then I remembered there was another difference between a maquahatl and a sword. I faked a downward slash at his belly, which brought his club up in a parry that made my blade slip off. Then instead of continuing with another slash, I brought the point up and lunged toward his belly with my hand low.

I felt a moment's resistance as the point pierced the lizard-skin stomacher, then a slow, easy slide as I sliced into his bowels. The blow forced him back against the edge of one of the tables and his eyes widened. I leaned into the sword, putting my weight behind it, forcing the point deeper into his belly and ripping up until it grated on the breastbone. His eyes widened, his mouth moved, but only blood came out to run down the beaten gold gorget of the god Quetzalcoatl. I eased the pressure and he slumped to the floor, my sword still in him.

I leaned back against the wall, my chest heaving. The cuts on my legs were bleeding profusely, my shoulder was still numb with pain, but there was more blood running down my right arm and that side of the chest. My left wrist was throbbing as if I had sprained it. All in all, I looked like the victim of a particularly inept sacrificial priest. But I was alive, and right now that felt better than being crowned Emperor Himself.

"Well done, young sir," came an all-too-familiar voice from the doorway, "well done indeed."

Foureagle came stumping into the room, accompanied by five or six hard-looking men. "I trust you have recovered the missing items."

I gestured toward the still figures on the tables. "In there. One in each."

The old man bent over the nearest table and examined its burden. "Ah, yes. Ingenious and even, perhaps, theologically sound—from Toltectecuhtli's perspective, of course."

"What will you do with them?" Not that I really cared.

"Why, return them to the huetlacoatls, of course. Oh, you mean the people? We will save them, if we can." He gestured to the men behind him and they disappeared down the corridor.

"You look as if you could use some tending to yourself." He laid his hands, oddly gentle, on my shoulder, testing the wound. "Yes, we must get that attended to. But not here. Can you walk? Ah, excellent. I am afraid this place will shortly suffer an unfortunate accident. A fire, I believe." He looked around appraisingly, nodded, and stroked his chin. "Yes, I think a fire will do nicely."

He half-supported me as he guided me toward the door. "But I do hope you will come and visit me. After you have healed, of course. We have so much to discuss. Your future, for example, and perhaps some additional employment. Yes, I think we must discuss that, young sir."

I thought about how I would explain working for the Emperor's Shadow to Uncle Tlaloc. Then I thought about Uncle Tlaloc's probable reaction. Then I thought about what Foureagle certainly would do to me if I refused. Turning of the cycle or not, my luck hadn't changed.

With that thought, I let them guide me down the corridor and out into the piss-warm rain of night.■

Surprise is the greatest gift which life can grant us.

— Boris Pasternac

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H. G. Stratmann, MD

SUSPENED ANIMATION THE COLD FACTS

It's an old standby in science fiction, but it isn't easy. . . .

Suspended animation—greatly slowing or stopping the body's metabolic rate so a person doesn't age appreciably—has a long tradition in science fiction. Early stories like *When the Sleeper Wakes* and *Armageddon 2419 A.D.* used mysterious drugs, gases, or freezing to put characters into prolonged "sleep" for one-way time travel to the distant future. Modern SF has explored the social and political dimensions of dealing with the frozen dead-but-not-dead, vividly described by the Pohl-Niven term "corpsicle."

In the "real" world, suspended animation would be useful for stabilizing a critically injured individual (e.g., on a battlefield) before transporting them elsewhere for definitive care, or preserving someone with a currently fatal disease until medical science finds a cure. As already used in SF, it could also facilitate interstellar travel at well below the speed of light by greatly reducing the food, energy, and recycling requirements a starship needs to support active versus "suspended" passengers for years.

But can a person really be put in a state virtually indistinguishable from death—with no breathing, heartbeat, or even detectable cellular activity—and then revived days, months, or years later, none the worse for wear? Current capabilities fall far short of this goal. However, much has been learned recently about what kinds of problems must be solved to safely place humans in suspended animation indefinitely—and the first tentative steps taken to deal with them.

Fish Do It, Reptiles Do It . . .

Suspended animation occurs in Nature. Conditions of extreme cold, lack of water, and reduced oxygen cause animals ranging in complexity from bacteria to mammals to markedly reduce, or even cease, metabolic activity. Microfauna like brine shrimp cysts, tardigrades,

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and nematodes can be completely dried out, with no measurable metabolism, then brought "back to life" when water is restored. Intertidal marine invertebrates like barnacles and mollusks experience repeated freezing and thawing, as well as lack of oxygen, during winter as tides rise and fall. Spiders, ticks, and many insects can survive prolonged temperatures of -50° C. Land snails are capable of "estivation"—a state of dormancy induced by drastically reduced availability of water. They can remain dormant in their shells for several years.

Certain cold-blooded vertebrates have similar abilities. Like snails, spadefoot toads and lungfish may estivate for years. Goldfish can do without oxygen for up to 16 hours at a temperature of 20° C, and a week at 5° C. Crucian carp and freshwater turtles spend up to four months submerged in water just above the freezing level, adapted to a metabolic rate about 10 percent of normal, and without breathing. Adult females of the wood frog, *Rana sylvatica,* can survive 13 days at a body temperature of -2.5° C, without respiration, heartbeat, or blood flow—and with 65 percent of their bodies converted to ice.

Six of the 34 orders of mammals contain species that *hibernate*. With one partial exception, all are small animals—the murine opossum, European hedgehog, brown bats, and certain lemurs, squirrels, mice, and hamsters. Most hibernate during cold winter months. (Dwarf and mouse lemurs, native to Madagascar, actually estivate—becoming dormant primarily under dry rather than cold conditions.) At environmental temperatures ≤ 0° C, their metabolic rates fall as low as 1 to 3 percent of normal. Body temperature, usually 35° to 38° C, decreases to 2° to 6° C. It can even reach several degrees below 0° C in the arctic ground squirrel.

The black bear is the only large mammal that "hibernates"—and its capability is much less than these smaller animals. Its body temperature falls to only 33° C, and metabolic rate to 30 percent of normal.

Unlike cold-blooded vertebrates, the hibernating mammal's breathing and heartbeat slow but don't stop. In the ground squirrel, the heart rate decreases from 200 to 300 beats per minute to seven to ten per minute as body temperature falls from 37° to 5° C. Respiratory rate drops from 100 to 150 breaths per minute to one or two per minute. Electroencephalographic (brain wave) studies indicate the hibernating state resembles deep sleep, without the rapid eye movement (REM) phase close to a waking level when dreaming occurs.

Entering a state approximating suspended animation has survival benefits for animals periodically exposed to cold and lack of oxygen. In mammals, maintaining normal body temperature during winter would require eating much more at a time when food is scarce, or mobilizing their bodies' energy stores, particularly from fat. To do that, a mouse would have to "put on" an amount of fat *three times* its body's normal weight. Metabolic rate would also have to increase severalfold to make up for body heat lost to the cold environment.

Conversely, by hibernating, ground squirrels use 12 percent of the energy they'd need if they stayed active. The rate at which biochemical processes occur falls two- to threefold with each 10° C reduction in temperature. This accounts primarily for the thirtyfold or more decrease in metabolic rate when the hibernating animal's body temperature falls to just above 0° C. At this low metabolic rate, the mammal's fat stores are adequate to meet their nutritional needs.

To return to normal body temperature and "wake up," hibernating animals use stored fat ("brown adipose tissue") to generate the heat needed for internal rewarming via specific biochemical reactions. However, the *net* energy saved by hibernating is much greater than what's needed for rewarming. This is despite

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the fact that mammals don't hibernate continuously during winter, but have repeated cycles of prolonged hibernation alternating with short periods of rewarming and wakefulness.

Hibernation may reduce an animal's aging rate. In one study, hamsters that hibernated poorly when exposed to cold had a life expectancy of 727 days, compared to 1,093 days in those who hibernated well. The average number of active, nonhibernating days was 687 for the poor hibernators, and 809 days for good hibernators—a much longer life span, if you're a hamster.

Cold Comfort

Well, if fish, turtles, and rodents can be chilled below freezing for long periods, then revive to live another day, how about us? Why can't you snuggle up in a spacious freezer (after prepaying a staggering electric bill), and set a timer to defrost yourself just in time to watch Super Bowl MXXXIV?

Unfortunately, putting yourself "on ice" like that would only turn you into very old cold cuts. The basic reason why you can successfully freeze and thaw a fish, but not a fisherman, is—their biochemistry and anatomy are too different.

Freezing a body produces ice crystals both inside and outside its cells. This is nearly uniformly lethal when it occurs inside cells, mainly by damaging subcellular structures (e.g., the nucleus and mitochondria) and forming "compartments" within the cells' fluid (cytoplasm). When extracellular water freezes, it disrupts connections between cells and draws unfrozen water from them, leaving the cells dehydrated and greatly increasing the concentrations of ions and other solutes. This, in turn, can cause irreversible denaturing of proteins (think of an egg after it's been hard-boiled) and other permanent injuries. Cells are virtually certain to die when ice content exceeds 65 percent of total tissue or body water. Some cell components are damaged well below this level.

To survive the nasty effects of freezing, animals must adapt themselves biochemically. Freezing must be confined to extracellular fluid spaces, cell shrinkage curbed, cell membranes and proteins protected. Finally, cells must remain viable despite the marked reduction of oxygen and nutrients produced by freezing and diminished blood circulation, respiration, etc.

Different species protect themselves in different ways. Nonmammals make their cell membranes more resistant to low temperatures by changing the lipids (a group of organic compounds that includes fats) in them, and using protective substances (e.g., trehalose and proline). The amounts and isoforms of enzymes and proteins within cells also change to improve cold tolerance. Special proteins outside the cell induce slow freezing and prevent formation of large ice crystals, thus regulating passage of water from intracellular to extracellular areas and minimizing cell damage.

For example, in freeze-resistant species of frogs, the bulk of their frozen blood and other internal fluids forms in large body cavities rather than their organs, thus reducing damage. Low-molecular weight carbohydrates like glycerol, sorbitol, and glucose act as *cryoprotectants* ("antifreeze") inside cells. They accumulate in high concentrations, reducing ice formation and stabilizing proteins against denaturation.

Lowering body temperature (and hence metabolic rate) drastically reduces the amounts of carbohydrates, proteins, and fat needed to maintain life. However, even the frozen or hibernating animal must use some of these "fuels" to survive, and make do with reserves already stored in its body. These animals use biochemical pathways for generating energy that are more efficient than we humans employ. Also, their body organs are much more tolerant to lack of oxygen than ours.

Cell metabolism involves processes that generate adenosine triphosphate

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(ATP), the primary molecule providing energy for cell functions, and those that use ATP. Reactions that utilize oxygen to create ATP (aerobic metabolism) are much more efficient than those that don't (anaerobic metabolism). In mammals, one molecule of glucose produces up to 36 molecules of ATP via biochemical pathways that use oxygen, and generate waste products of water and carbon dioxide—both relatively easy to clear from the body. Conversely, when sufficient oxygen *isn't* available, anaerobic metabolism produces only two molecules of ATP per glucose molecule and forms lactate—an acid that's more difficult to eliminate.

A turtle's biochemistry is *much* better adapted than ours to handle the reduced energy and increased lactate production associated with anaerobic metabolism. Its brain can tolerate for months conditions that would irreversibly damage our somewhat more complex cerebral cortex within minutes. Goldfish use a metabolic pathway whereby lactate is converted to ethanol and carbon dioxide, which are excreted through its gills. Marine mollusks use a more efficient form of anaerobic metabolism than humans do. It generates up to seven ATP molecules from a molecule of glycogen (the storage form of glucose).

Human physiology allows none of these options. Our brains in particular are very oxygen demanding. Though the brain constitutes only about 2 percent of an adult's mass, it receives 13 percent of the body's total blood flow (with the oxygen and nutrients blood carries), and consumes 20 percent of its oxygen. Thus, we can only marvel at, rather than share, these other creatures' capabilities for suspended animation. Then again, there are downsides to being one of them. Few, if any, turtles have the opportunity to read *Analog*. And though the idea of being, like a goldfish, "stewed to the gills" by nature may appeal to some, humans are adept at getting ethanol into their bodies by other means—and don't have to worry about hungry pussycats.

Mammals able to hibernate use physiological adaptations less drastic than these—but still considerably different from any *Homo sapiens* can muster. The exact mechanisms for many of these adaptations, such as hibernators' ability to maintain ATP production and cell function at low temperatures that would kill the cells of nonhibernators like us, are still unknown. One important difference is their metabolic response to reduced oxygen availability. Humans and other nonhibernating mammals use primarily carbohydrates at such times—an inefficient and rapidly depleted "fuel." Hibernators suppress carbohydrate metabolism, and use their fat stores instead.

Hibernation is triggered primarily by a fall in environmental temperature—perhaps by the thermoregulatory center ("thermostat") of the animal's brain resetting itself to a lower temperature. However, other factors (decreased daylight and food or, in some hibernators, internal biorhythms) may also contribute. Some mammals (e.g., hamsters) kept continuously in a warm environment don't hibernate, while others (e.g., squirrels) show torpor during winter months even if kept warm.

Hibernation induction trigger (HIT) is a chemical produced by some winter-hibernating mammals. Its exact molecular structure hasn't been identified, but it's believed to be an opiate—stimulating the same or similar cell receptors in the brain as opium and morphine do. Injecting HIT into a mammal capable of hibernating produces a state mimicking hibernation. Whether it could do this in humans isn't known.

As in other areas, when it comes to ability to hibernate, "size matters." No mammal larger than a marmot (about 5 kilograms) *truly* hibernates. Larger mammals had less physiological "incentive" to evolve this ability. As an animal's

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body mass increases, basal metabolic rate also increases—but not as rapidly. A tenfold increase in body mass produces only a fivefold rise in metabolic rate. Thus, instead of the huge fat stores (300 percent greater than its usual body weight) a mouse would need to maintain normal body temperature through the winter if it didn't hibernate, a human-sized animal would require increasing body mass by a more practical 20 percent. This physiological impetus to increase fat stores as winter approaches may, however, help explain our urge to gorge on goodies around Thanksgiving, Christmas, etc. (Or maybe not.)

Small mammals also require relatively little energy to rewarm themselves. Larger ones (like us) would require much more energy to "heat up" to normal body temperature again—thus decreasing the net energy-saving benefits of hibernation.

Freezing in a Winter Wonderland

So if, unlike a hamster, keeping you or me in the cold too long won't make us hibernate, what does happen? The answer isn't pretty.

At environmental temperatures around 22° C, an unprotected human being can maintain his (or her) normal core (internal) temperature of 36.4° to 37.5° C quite well. However, human anatomy and physiology is poorly adapted to tolerate hypothermia (a body temperature below normal).

Unprotected exposure to cold, like someone going for a leisurely stroll outdoors during a Minnesota winter clad only in his birthday suit, activates the thermoregulatory center in his brain's anterior hypothalamus. Compensating reflexes try to maintain the temperature of critical organs (e.g., brain and heart)—even if that means sacrificing body parts less immediately essential to life. Blood vessels constrict, particularly in the skin, arms, and legs. This reduces blood flow and heat loss there—but also makes them most vulnerable to injury (e.g., frostbite). The "hunting phenomenon"—rhythmic waves of vasodilation, with constricted blood vessels briefly "opening up" in the skin and extremities—partially protects these body parts.

Shivering—defined technically as involuntary contraction of muscles in the body's trunk—increases heat production. However, this is at the expense of increased expenditure of energy and nutritional stores. Heart rate, blood pressure, and breathing rate all increase. The victim becomes agitated ("I'm cold!").

If, despite these reflexes, his body's core temperature falls to 35° C, vasoconstriction and shivering intensify. Metabolic rate rises up to six times normal as he tries generating enough heat to keep internal organs "warm." Nonetheless, brain dysfunction is likely, with confusion and apathy ("Who cares if I'm cold.")

At 30° C, his ability to resist further falls in temperature is severely impaired. He's now coldly silent when you speak to him, and alternately shivers and stiffens. Breathing rate decreases. Metabolic rate falls below normal, declining about 6 percent for each additional 1° C fall in core temperature. Fluid losses cause dehydration. Serious, but not necessarily lethal, arrhythmias (abnormal slow or fast heart rhythms) may develop.

At a core temperature of 25° C, he no longer responds to painful stimuli. Shivering stops, and his body is stiff. Metabolic rate is 50 percent of normal. Ventricular fibrillation (VF), an arrhythmia in which the pumping chambers of the heart "quiver" instead of contract, may occur. It's the usual "final" event in severe hypothermia.

At 20° C, he appears gray, doesn't breathe, and *looks* dead. The brain shows no electrical activity. VF is likely, and the heart stops.

Melting Your Cold, Cold Heart, Liver, etc.

But there's a small chance for recovery even in severe hypothermia. The re-

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duced metabolic rate and oxygen requirements that help protect hibernating mammals from low body temperature also, to a limited extent, protect humans. Though blood flow to the brain decreases six to seven percent for every 1° C fall in core temperature, neuronal metabolism falls at the same rate—thereby delaying permanent damage. Recovery has been reported in individuals with core temperatures of 17° C, or after an hour of complete submersion in near-freezing water. Thus, no hypothermic person should be considered dead until he's been rewarmed to near-normal temperatures and resuscitation hasn't worked.

Rewarming may be "passive," like bringing the person into a room-temperature environment. In an isolated outdoor area, placing him in an insulated sleeping bag and/or having a rescuer use body heat to warm him, may help as "first aid." When available, "active" external rewarming can be done with heating pads, putting him in warm water, or using forced-air convection heaters. Treatment of severe hypothermia includes infusing heated (40° to 45° C) saline intravenously and into the abdomen, and giving warmed oxygen. Core temperature should be monitored with a thermistor probe inserted in the rectum. If available, cardiopulmonary bypass (a heart-lung machine) may help.

Cardiopulmonary resuscitation (CPR) can be used if no breathing or pulse is present. However, VF may be precipitated by merely jostling a severely hypothermic person, e.g., when moving him to a warmer environment or during CPR. Standard treatments for VF—electrical shocks to the chest and medications like bretylium and lidocaine—probably won't work until he's rewarmed.

Although the hypothermic individual requires less oxygen due to reduced metabolic rate, there's also less oxygen than normal *available* to supply his needs. As body temperature falls, hemoglobin in red blood cells gives up oxygen less readily. At 12° C, it doesn't give up oxygen at all. The small amount of oxygen normally dissolved in blood can be used by the brain and the rest of the body. However, it's not enough to prevent increased production of harmful substances like lactate, glutamate, and xanthine oxidase.

When (hopefully) adequate oxygen is restored, metabolic activity of cells increases again. However, this also allows these harmful chemicals to act—injuring cell components directly (e.g., by swelling and rupture); producing oxidizing "free radicals" that damage cell proteins, lipids, and DNA; and stimulating substances that cause inflammation (e.g., cytokines) and blood clotting (like thromboxane A_2).

Thus, even if the person survives hypothermia itself, body cells can still be damaged after rewarming. Vital organs like the brain and heart may be injured directly or indirectly by blood clots (e.g., a stroke). Life-threatening infections and pulmonary edema (fluid in the lungs) can occur after even the best available treatment.

Keeping a Cool Head

In certain medical situations, under very controlled conditions, intentionally cooling a person may help *protect* the brain, heart, and other vital organs. "Therapeutic hypothermia" may be defined as mild (34° to 36° C), moderate (28° to 32° C), deep (15° to 25° C), or profound (less than 15° C). It can entail cooling the whole body or individual organs, e.g., packing the head with ice bags to "chill" the brain, or directly infusing cooled fluids into the heart. Uses include protecting patients having brain surgery; with head trauma or other conditions producing increased pressure in or around the brain; after a cardiac arrest with reduced blood flow to the brain; and during heart surgery.

More aggressive measures involve stopping the patient's heart, supporting

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circulation using cardiopulmonary bypass, and cooling his body to as low as 15° C. This represents a reasonable approximation of "suspended animation." However, with these techniques, the "safe" limit for keeping a person in such a state is only about *one hour*. After that, the complications described previously (damage to body organs, blood clots, etc.) become increasingly likely.

Recent experiments with dogs indicate the safe limit for suspended animation might be pushed to three to five hours. In one method, the dog is cooled to less than 10° C. Its blood is drained and replaced with a maintenance solution similar to the fluid inside cells. This solution reduces risk of blood clots forming during both cooling and, before it's replaced by blood again, rewarming.

Several intravenous medications can depress the brain's metabolic functions. Barbiturates and newer agents like etomidate are used for this purpose during general anesthesia. However, the degree of "suspended animation" produced by such medications is minimal—and they can be used safely for only a very short time.

All of Me, Why Not Freeze All of Me

Unfortunately, these techniques won't keep your whole body in suspended animation nearly long enough to get you to Super Bowl MXXXIV. However, *parts* of you—individual cells and organs—can be preserved more efficiently.

Successful *cryopreservation* of human spermatozoa in liquid nitrogen (temperature about -196° C) was first reported some fifty years ago. Since then, comparable techniques for cryopreserving other human cells—oöcytes (egg cells), stem cells (precursors of mature cells), embryos, and tissues like skin, bone, and parathyroid gland—have been developed. Similar cells from cattle, mice, and other animals can also be preserved.

Cells are first exposed to cryoprotectants like glycerol, dimethyl sulphoxide (DMSO), sucrose, or ethylene glycol, then cooled to subfreezing temperatures. Ice formation is induced in the extracellular space by "seeding" it with ice or a chilled needle. This gradual, controlled freezing of extracellular fluid helps prevent sudden production of large, rigid ice crystals that would otherwise occur and damage cells.

At subfreezing temperatures above -130° C, ice crystals can still grow and injure cells. To prevent this, long-term storage requires using liquid nitrogen to reach temperatures well below that level. Although most cryopreservation methods use gradual cooling, an "ultrarapid" protocol for embryos involving initial exposure to high concentrations of cryoprotectants followed by immediate immersion in liquid nitrogen has been described. Depending on the type of cell and protocol used, cryopreserved cells may be "thawed" to room temperature as gradually as 8° C per minute—or as rapidly as 100° to 300° C per minute.

Alternatively, *vitrification* may be produced. Cooling produces slowing of not only biochemical (e.g., enzymatic and protein-synthesizing) activities, but reduced translational motion of water, cryoprotectants, and other molecules in a liquid state. Eventually viscosity is so high that both metabolism and molecular motions cease, cell components stay in their "correct" anatomical place, and these *unfrozen* fluids become a "glass"—a liquid too cold to flow, its molecules having too little energy to move anymore. If cooling is rapid enough, the "glass transition temperature" (about -100° C) is reached before significant amounts of damaging ice crystals form. Unlike freezing, vitrification theoretically shouldn't injure cells. Their water is still technically a liquid—but in an arrested state of motion.

Cooling and rewarming cells inevitably cause some to be damaged or destroyed. Sperm cells seem to be the

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"hardiest" ones for cryopreservation. Current opinion is that an appropriately large specimen can be stored indefinitely for later warming and successful fertilization. The upper "safe" limit for storing human embryos isn't known, but a rather arbitrary limit of five years is often used. Rate of births following intrauterine transfer of thawed human embryos produced by in vitro fertilization was reported in one series to be 6.7 percent—low, but comparable to the 7 percent rate seen with "fresh" embryos not frozen beforehand.

Conversely, few human infants have been born after fertilization and implantation of cryopreserved mature oöcytes. Studies in mice indicate that using frozen *immature* oöcytes (before ovulation)—or slices of the ovary itself—might be more successful. For example, chemotherapy and/or radiation treatments a young woman requires to treat cancer could, as a side effect, destroy these normal cells too, making her infertile. Harvesting and cryopreserving these cells before such treatments could preserve fertility by allowing oöcytes to be used later for in vitro fertilization, or ovarian tissue could be reimplanted in her.

Methods to preserve other "simple" human tissues like red blood cells and corneas are also available. However, there are no proven techniques yet for freezing and banking large, complex human organs like livers or hearts for transplantation. These organs are especially vulnerable to injury during the freezing process. It's much more difficult to ensure that appropriate amounts of cryoprotectant are reaching the tightly-bound cells of a large three-dimensional object like the liver than with individual, suspended cells like spermatozoa. Too little cryoprotectant, and the cells are damaged during freezing. Too much, and they're damaged by the toxic effects of the cryoprotectant itself. Also, these organs contain different *kinds* of cells—and the ideal cooling and thawing rates to minimize cell destruction for each kind may be significantly different.

Extracellular ice forms preferentially in the organs' blood vessels. Dehydration of surrounding tissue causes water to accumulate and freeze in these vessels, making them overdistend and rupture. Even if freezing doesn't kill the cells themselves, it damages important substances outside the cells, like those that support fine blood vessels (capillaries) or hold one cell in contact with another. These effects cause inadequate blood supply to the organ after transplantation, and injure or kill its cells. Even if cells aren't irreparably damaged by freezing, they can be injured during the equally difficult task of removing cryoprotectants and uniformly warming them during the "revival" process.

Recent animal research (e.g., successful short-term cryopreservation of kidneys at -45° C) indicates these problems aren't insoluble. However, even now organs *can* be preserved for short times outside the body at temperatures just above freezing. At 0° to 4° C, tissues removed from the body and without circulation remain viable at least 10 to 12 times longer than at normal body temperature. Harvested organs are flushed of blood using a cold solution that lowers their temperature to about 4° C over 5 to 15 minutes. They are then stored in ice to maintain that temperature or, especially with kidneys, attached to a pump that perfuses them with a preserving solution. Such solutions include solutes like glucose or mannitol that reduce cell swelling, and ions (e.g., potassium and sodium) to help maintain cell viability.

These methods currently allow preservation of a kidney, liver, or pancreas for up to about 3, 1.5, and 1 day(s), respectively. The "safe" interval between harvesting and transplanting a preserved lung or heart is significantly shorter—about six hours for lungs, and as little as four hours for hearts. While a transplanted kidney or liver doesn't have

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to resume full function immediately after transplantation, a heart does—and thus its cells can't tolerate as much "stunning" as these other organs.

Reperfusion injuries also occur to these organs following transplantation. The oxygen free radicals, cytokines, etc., that cause cell damage after a hypothermic person is rewarmed are also produced and damage transplanted organs when blood supply, and hence a "normal" amount of oxygen, is restored.

Napping in (Liquid) Nitrogen

These problems with freezing and thawing individual organs are magnified manyfold when trying this with a whole body. Just as falling from a plane at 10,000 feet without a parachute doesn't kill you but hitting the ground does, putting someone in liquid nitrogen is easy. But, at least with current technology and techniques, we can't get him to walk and talk again when we warm him up.

Most important of all is the need to preserve and restore the organ that allows us to function at a human level of intelligence and action—the brain. A good news/bad news scenario—"After defrosting him his spleen's doing great, but his brain got a bad case of freezer burn and spoiled"—would defeat the whole purpose of preserving someone. Ways must be found to prevent or repair any damage caused to the brain—especially the components that express our memories, personality, knowledge, and everything else that makes a person an individual.

Present-day interest in *cryonics* (inducing reversible suspended animation in humans using low temperatures) dates back to the early 1960s. Robert C. W. Ettinger, a physics teacher, wrote a book, *The Prospect of Immortality,* suggesting that an individual's body might indeed be preserved and, when a hoped-for future technology is capable of doing it, ultimately repaired and revived. James H. Bedford, a psychology professor dying of cancer, was the first person to actually gamble on this possibility, arranging in 1967 for his body to be preserved in liquid nitrogen—where it still is.

Our current inability to revive a cryopreserved body hasn't prevented dozens of people since then from having themselves "buried" in liquid nitrogen, too, or hundreds more from signing up to have it done when they die. Currently several organizations in the United States, like the Alcor Life Extension Foundation, the Cryonics Institute, CryoSpan, and similar ones in other countries offer such services.

Cryonics is the ultimate "long-shot" gamble to cheat death. It's based on a person's hope that revival techniques will ultimately be developed; future medical science will develop a cure for whatever "killed" him in the first place; someone in the (probably already greatly overpopulated!) future will bother to revive him if that happens; and nothing will go wrong in the meantime, like a rogue asteroid striking the Earth or his relatives deciding they could use Uncle Ned's money for better things than paying to keep him frozen. In fact, the bodies of several original "pioneers" in this venture were eventually allowed to thaw due to nonpayment by relatives. Even if global catastrophe doesn't intervene and he's blessed with devoted descendants, something as simple as mechanical or electrical failure of the cooling systems for his liquid nitrogen might cause premature defrosting.

Legally, a person must already be clinically dead (e.g., no respiration or heart beat, no response to deep pain, etc.) before cryopreservation can be started. However, with every passing second after clinical death and before the body's cooled to the temperature of liquid nitrogen, more and more cells (particularly in the brain) are being injured. Starting cryopreservation while the person is still living might reduce this damage. However, because the chances of ultimate revival are slim (for technological

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or other reasons), this process might be considered merely a sophisticated form of assisted suicide—with the attendant ethical and legal questions *that* raises.

Though techniques for preparing bodies for long-term cryopreservation and storage vary in details, basic procedures are the same. In the "ideal" situation, immediately after clinical death the newly deceased's body is injected with heparin (to reduce blood clotting), and sometimes other medications to reduce cell injury. A machine for performing CPR, including a "thumper" for chest compressions and a respirator, is started. The body is cooled with ice bags or a cooling blanket to around 16° C. The CPR machine is then stopped. Blood is drained from the body, and replaced by a cryoprotectant like glycerol, DMSO, or propylene glycol. This is done by opening the chest and placing flexible tubes (catheters) into the large blood vessels arising from the heart or, less invasively, from the outside through carotid (neck) or femoral (groin) vessels.

The body is then gradually cooled, over as long as a week, to about -79° C using dry ice vapors. Another week of exposure to liquid nitrogen vapors gets its temperature down to -196° C, ready for storage in a "cryostat"—a generally cylindrical storage unit made of metal (similar to a Thermos bottle) or fiberglass. There the person is immersed in liquid nitrogen, suspended vertically in a head-downward position (so the feet and not the head will thaw first in case of a cooling problem), and waits in hope for a healthier, more active future.

An alternative method, "neurosuspension," requires an additional level of optimism about future medical technology. Instead of saving the whole body, only the head (and brain) is stored. Advantages of this method include more rapid reduction to cryogenic temperatures, less cost for storage (e.g., replacing liquid nitrogen that slowly evaporates), and easier, safer transport to another location should that become necessary.

The major *disadvantage* is obvious. Unless the revived person is to become more than "The Brain That Wouldn't Die," techniques for successfully grafting the head/brain to a new body, "scanning" its memories and personality for download to a new cloned body or computer, or comparable solutions must be developed.

The odds of any individual preserved by current or past methods ever regaining functional existence with a reasonable approximation of his former personality and memories seem slim. Significant damage to the brain occurs by all these processes. Even if anatomic health and physiological function can be restored in the brain via a future repair nanotechnology, there's no guarantee the information needed to reconstruct his mind and mental individuality is still there. The complex interplay of neurotransmitters, synaptic connections, etc., that produce human consciousness and intelligence are still barely understood. We don't know what *specific* combination of chemicals and neurons produce the things that are *uniquely* ours—memories of pleasures like our first kiss, or the complex blend of intelligence, feelings, hopes, and experiences that are ours alone. If the anatomic and biochemical encoders of *that* information are destroyed shortly after clinical death, or in the weeks before the brain is fully cryopreserved, then that part of the person's mind is truly lost.

Even the best nanotechnology can't restore what no longer exists. The most that could be expected then is bringing your brain back to life—but as a virtual *tabula rasa*. And if the restored "you" doesn't have your own individual self-awareness or memories anyway, there are simpler ways of creating such a "new you." Preserving your unique genetic pattern as a sample of DNA or cell culture—both of them very compact and easily stored at room temperature—pending the (probably near-future) availability of human cloning is more cost-ef

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fective, and you don't have to die just yet to do it.

Or, if you don't mind sharing half the genes in your new "self" with someone else, there's an old-fashioned method that's proven popular over the years. Its initial cost is zero (or at least negotiable), and is considerably more pleasant than being dunked in liquid nitrogen.

Keeping Yourself on Ice

Clearly, to go into "suspended animation" using cryonic methods, you must minimize damage to the brain. Research is going on right now to find new methods to do this.

One such proposal, the so-called "Prometheus Project," is an effort by certain scientists (including experts in cryobiology) and companies to do just that, and more—to ultimately perfect whole-body suspended animation. Its first goal is to show that fully reversible cryopreservation of the central nervous system (brain and spinal cord) is possible.

The first phase of such research would involve identifying the cryoprotectants that will best penetrate the brain, and determine how to administer them to minimize their toxic and maximize their protective effects on the various types of cells (neurons, astrocytes, glial cells, etc.) that compose it. Complete vitrification—effectively slowing the normal dynamic metabolic activities of cells into a "snapshot" state without harming them—is the desired goal.

To do this, a cryoprotectant must be used at low enough concentration to avoid toxicity, but high enough to prevent "cooling injury" (damage to cells produced by cooling to nonphysiological temperatures even without freezing). It must both allow vitrification and avoid devitrification (rapid freezing of extra- and intracellular water during rewarming). To prevent devitrification, the brain and other organs must be rewarmed rapidly at a rate of about 300° C per minute, so ice doesn't have time to form and damage cells.

Promising cryoprotectants (like a recently developed perfluorocarbon thought to be, unlike conventional ones, nontoxic) will be used on isolated animal heads cooled to -140° C, and their brain cells studied by light and electron microscopy for damage after rewarming. Prior studies found that, with suitable cooling protocols, the ultrastructure of cryopreserved brains seems reasonably intact. But while "looking good," without obvious cell damage, is a necessary prerequisite, it's critical to determine whether "thawed" brain cells *function* normally. This will start with basic tests of metabolism and electroencephalograms, then proceed to more sophisticated tests like assessing evoked potentials (electrical activity in the brain produced by external stimuli, like light or sound). Ideally, the rewarmed, reperfused brain should even show signs of consciousness.

If this research is successful, the next phase would involve transplanting a cryopreserved brain or head to a new body. While technically demanding, successful surgical transplantation of a dog or monkey head to another body has been done previously. Demonstration that the thawed, transplanted brain/head could recover normal physiological and mental functions for even a short time would show "proof of principle," even if long-term viability is low due to factors like rejection by the host body.

Next would come attempts to cryopreserve the animal's brain and head to ≤ 70° C while still connected to its original body—then successfully reviving it to show full recovery of mental functions. While ideally this would include cryopreserving the whole animal, as mentioned earlier the procedures needed to minimize damage to different cells and organs (ideal rates of cooling/rewarming, the most effective cryoprotectants, etc.) may vary significantly. Thus, as an intermediate alternative to whole-body "suspended animation," the brain/head alone might be cryopre-

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served while the rest of the animal's body is kept "only" hypothermic at a temperature above 0° C.

Once the safety and efficacy of cryopreserving an animal's brain and body is demonstrated, the next step would be trying it in humans. Presumably, for legal, ethical, and practical reasons, finding healthy volunteers for such procedures might be difficult. Conversely, individuals with terminal diseases and short life expectancy might be willing to try.

To Freeze or Not to Freeze

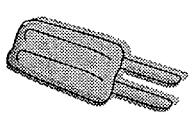
Our current ability to put whole humans or even individual organs into "suspended animation" is minimal. Human physiology is not adapted for or, except perhaps by very advanced genetic engineering, adaptable to the levels of suspended animation certain fish and reptiles achieve naturally, or even the ability to hibernate some small mammals possess. Whether cryopreservation and restoration of clinically dead or still living humans is even possible remains unknown.

However, development of new procedures and materials (e.g., blood substitutes) continue to "push the envelope." Based on recent animal studies, the present limit of about one hour for keeping humans safely in hypothermic "suspended animation" probably can be extended. Being able to do this for even two or three hours could make the difference between life and death when transporting an injured person for definitive care. Cryopreservation of individual human organs may well become routine within a decade, allowing true banking and immediate availability instead of the uncertainties and time constraints of current preservation methods.

While technical obstacles to brain or whole-body cryopreservation of humans remain formidable, methods with the potential for safe, long-term, reversible suspended animation have been developed and are ready for testing in animals. How well they'll work and what kind of unforeseen problems will be found can't be predicted—but, based on current knowledge, there's no *theoretical* reason why they might not work. While the odds seem poor, it can't even be ruled out that a future nanotechnology might indeed be able to revive the minds of those optimistic individuals already "sleeping" in cryostats.

The basic purpose of "suspended animation" is to preserve and prolong human life. However, this isn't the only potential method for keeping people alive well past humans' current average life span. As Ben Bova outlined in a recent *Analog* article ("Slowboat to the Stars!" February 2000), active research is proceeding on retarding or even reversing the aging process, perhaps by restoring "healthy" levels of key hormones and preventing cell senescence and death. Spending the next few centuries actually *living* a life of youthful vigor would generally be preferable to spending them in even the safest suspended animation. Conversely, if such "fountain of youth" methods take decades or centuries to develop, near-future development of suspended animation might allow a person to survive until they *can* go to their doctor's office for a rejuvenation shot.

With at least the possibility of prolonged suspended animation and these other medical advances being within reach, someone reading this article just *might* make it to Super Bowl MXXXIV after all. Hopefully that one will finally be a close game. ■



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Further information concerning the Prometheus Project and the cryonics services provided by several companies can be obtained using links at the Internet address <*http://cryonet.org/*>. As one would expect, these websites are heavily weighted towards viewpoints and information optimistic about cryonics and its potentials. Let the reader beware. . . .

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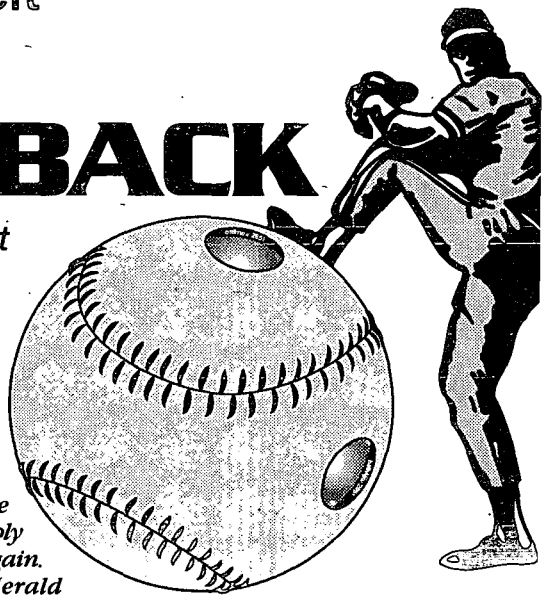
James Van Pelt

THE COMEBACK



Rules are an important part of what makes any game—but so are the players.

The art of fiction is dead. Reality has strangled invention. Only the utterly impossible, the inexpressibly fantastic, can ever be plausible again.

Red Smith in the New York *Herald Tribune* commenting on the 1951 Giants snatching the pennant race from the Dodgers after being 13 1/2 games back on August 12.

This game will teach you things. I can tell you that.

In 1951, the underdog New York Giants beat the Brooklyn Dodgers in a best-of-three playoff set to go on to the World Series. A hundred years later, in 2051, our manager, Old Deacon O'Doul, who had a keen sense of baseball history, pasted that Red Smith quote on the locker room wall and growled at the boys, "We're only nine games behind and it ain't August 12th yet. If any one of you has an ounce of quit in you, tell me now so I can give up hope and start dusting off my fishing gear."

Baseball's changed some since 1951. Vids everywhere, floating over the field, watching the dugout. Heck, there's vids in the bat and the ball. The home audience can switch views whenever they want. Players are stronger. New ways of cheating. In 1951 you didn't worry about genetically enhanced players, that's for sure. You didn't worry about being traded to Buenos Aires or Cape Town. Nobody knew about guys like Spooky, either, or humanity evolving. But more about the game is the same than is different, and a coach yelling at his club in the locker room humbles ballplayers the same way in 2051 as any other time.

In the silence that followed, Spooky Earl Waters leaned over to me and whispered, "What 1930s ballplayer said, 'There'll never be another one like me'?"

I said, "Dizzy Dean."

But other than a leaky shower head dripping in the background there was no sound, and the team looked glumly at the floor. The speech worked; we took both ends of a doubleheader against Cincinnati that afternoon.

Spooky had a career day against Cincinnati. He stood next to Deacon in the dugout and called the defense before the pitch, "Second base, two steps left, one hop," or "Deep right center." Deacon would run through his signals, shifting an infielder to one side or the other, or he'd move an outfielder. Poor

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Cincinnati failed to get a single base runner in the opener; everything went straight to a forewarned fielder. Spooky didn't miss once. They were quite a pair, Deacon, the gray old man leaning over to get the call from Spooky, who looked like a towheaded kid, his brows all wrinkled up in concentration.

It was a great game: the reason I loved baseball in the first place. At the end, the sun cut across the field; the smell of infield dust and chalk and grass filled my nose, and the home crowd raised a ruckus.

In the nightcap, they only scored one run, and it was unearned. Blue Blackburn walked a pair in the seventh inning, and then scored the first on consecutive wild pitches.

At the end of the inning, Blue stormed into the dugout, knocked over the water cooler, and kicked the bats. He grabbed the front of Spooky's shirt, picking him up before anyone could stop him. "You lost my shutout for me you miserable excuse for a . . . prostaterater!"

"Prognosticator," said Eddie "Crouch" Potato, our catcher, who put his hand on Blue's fist. "Put him down, Blue. You tossed those wild ones all by yourself."

Crouch was a quiet man, very gentle, but he weighed over two hundred pounds with no fat. He looked like the kind of guy who'd crush your spleen if you crossed him. The year before we had a rookie pitcher who refused to come into the locker room after a game because he thought Crouch was mad at him for shaking off a signal. Blue was nearly two hundred himself, but he knew it was a bad idea to rile his catcher, so he dropped Spooky and stalked down to the other end of the bench. "What good is he if he doesn't warn me about this kind of stuff?" As he went out to start the eighth, Blue slapped Spooky on the back of head. "Should have seen it coming, freak."

The vids picked up his behavior and replayed it on the big screen several times, which didn't help his mood. The crowd booed him.

Blue had won a lot of games, and he was a darned good pitcher, but he'd never earned a shutout. Not in Little League, not in high school or the minors. Never. It was just one of those weird things. Weird things are a part of baseball. Take Richie Ashburn of the '57 Phillies. He was playing in a game where a ball he fouled hit a fan. Ashburn, naturally was concerned, and he waited until they started to take the fellow out of the stadium. Then, on the next pitch, he fouled off again and nailed the same guy.

Afraid that he'd jinx himself, Blue never told anybody about the shutout, but we all knew he wanted it more than anything in the world.

Blue plunked the lead-off batter in the shoulder. No good reason for it, he was just mad.

The part of the crowd hooked into the batter's point of view winced on the pitch. They passed their V.R. goggles around so others could see it themselves.

Blue wasn't the brightest pitcher I'd seen in my twenty years as equipment manager. Somebody once said, "Open up a ballplayer's head and you know what you'll find? A lot of broads and a jazz band." That was Blue.

He never really did figure out what prognosticators did for the club. In '51 they were still pretty new. I mean, the whole idea of psychic *Homo telepathis*, which is what the papers called them, as a branch of humanity confused the heck out of a lot of people. Spooky and others like him who got little peeks into the future had only been in the league for a half-dozen years or so at that point, and a few teams didn't even use them. Heck, some people argued they would ruin the game, but baseball's survived all kinds of change. I mean, look at the designated hitter and artificial turf! You still have to throw and hit and catch, for crying out loud.

I'd asked Spooky once why he only

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knew where hit balls were going but no other part of the game, and he kind of hemmed and hawed without saying anything. He was a shy guy anyway, and darned small at a bit over five-foot, but he knew baseball like nobody's business—we'd swap trivia and stats all the time—and could tell a great joke. That's how he got hooked up with young Annabelle Martin in the front office. He made her laugh, and even though she was eight or nine inches taller than he was and looked like a model (which she had been her last two years of high school), it was understood they were an item. They'd meet for lunch in the hotel restaurant to split a sandwich when we were on the road. It was cute. I almost expected them to order one malt with two straws afterwards. At any rate, and not to get too far off the subject, Spooky said a hit ball released a distinctive and sharp flash in time he could track. Almost nothing else worked the same way, and he could only predict maybe twenty or thirty seconds into the future on a really good day, so he was no better at the race track than I was.

But he knew his trivia. Once I said to him, "Where'd the term 'Charlie Horse' come from?"

He grinned at me, that real open-faced smile where his face looks lit-up from behind. "Charlie Esper. Pitched for the Orioles in the 1890s. He ran so badly his teammates thought he looked like a lame horse, and ever since then a player with a leg cramp uses his name."

I thought for sure he wouldn't know that one.

After the second win, Spooky danced a jig on a bench in the locker room. Deacon gave him a game ball; only Blue refused to sign it.

Of course, Spooky had his slumps. Like all ball players, percentages ruled him. Sometimes he'd have streaks, too. Baseball's a streaky game; who can forget Joe DiMaggio, for the love of Mike? The day of the doubleheader against Cincinnati Spooky killed them, but other days he was useless. He carried a little towel, and if he wasn't seeing so good, he kept twisting it, like he was trying to wring out a vision of what was coming next. When his inner eye was working, he'd stick the towel in his belt or leave it on the bench.

After Cincinnati, Spooky went into a dry spell. About that same time, the tabloids ran a picture of Blue at a local dance place planting a big kiss on Annabelle Martin. She didn't look like she was struggling either, her eyes all bright and adoring. Don't know whether the slump had anything to do with the confrontation in the dugout or Annabelle, but I know Spooky started looking real distracted, and his eyes were red-rimmed.

He quit playing trivia with me, even when I tossed him some pretty easy chestnuts.

Over the course of the next few weeks, Spooky worked his way through towel after towel until they were no more than a tatter of threads. He got another from me and started on it. Didn't matter much to the club, though, even if he wasn't helping. We swept the Braves in four, split two games with the Mets, took all three against Tokyo in Tokyo, and went twenty-four for twenty-nine to finish the season a half-game back of the division leading Chicago who hadn't played badly in the final stretch themselves.

And wouldn't you know it, our last game of the season was in Chicago to make up for a rain-out in July.

Blue won five of his six starts after Cincinnati, and Deacon scheduled him in for the Chicago game. All that winning didn't make him any sweeter, though. The gossip columnists were making a fuss about Blue and Annabelle, him being a big name ball player and all, and she being so young and glamorous. Blue would bring in the clips, mostly to get Spooky's goat, I think, and then he'd talk dirty about her to the rest of the guys loud enough for Spooky to hear.

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Spooky moped around like a whipped dog. Like I said, his average dropped way off, and he started getting a lot of "false positives," where he'd tell Deacon to shift a player wrong; Deacon would flash the signals, and the ball would shoot through right where the fielder had been before. Deacon started to not trust in him so much. Still, Spooky produced in a couple of key situations. He never put down the towel though. Worried it pretty good, he did.

Most of the team caught on pretty quick to what was going on, but there's three or four like Blue on any squad, mostly second stringers, and they'd yuck it up at Spooky's expense. Crouch didn't like it, naturally, and he started tossing the ball back to Blue in the dirt or to the left or right so he'd have to step off the rubber until Deacon told him to cut it out.

"I don't know what's happening here, Crouch, but you're just hurting the ball club. I don't care what you think of the guy off the field, but he's a part of this pennant drive. You toss it up there nice and don't break his rhythm."

So it came down to the final game. Winner makes the playoffs. Loser gets to think about it all winter. After the national anthem, the team settled into the dugout except for Lemon Smith, our shortstop who batted leadoff, and Crouch who was on deck. On the bench, Blue started spouting off about Annabelle. "I finally pegged her," he said to his cronies real loud.

Spooky sat up like he'd been shot.

The players around Blue chuckled and slapped him on the back while Blue worked a ball in his hand.

"Wasn't worth the wait, though," Blue said. "All those looks, and I don't think she'd been round the block before."

Somebody said, "How'd you know, Blue?"

He turned away to answer, so I didn't hear, but his buddies burst out laughing like they'd never heard something so funny.

"And get this," said Blue. "She thinks I *love* her. She's probably registering silverware patterns right now. Hell, I haven't spent two nights alone this month."

Made me sick just to hear it.

By this time, Lemon stepped up to the plate, so they turned to watch. A couple of them yelled encouragement. In the other dugout, their coach was signaling like crazy. The pitcher wound up, and as he delivered, their second baseman took off toward first. Lemon slapped a perfect line drive to the gap, but the second baseman snagged it on the run. Spooky's Chicago counterpart had anticipated the hit, and Lemon was out. Our next two guys went down swinging, so we took the field.

Spooky didn't move from his spot on the bench. Deacon looked around after a bit and spotted him. "Get up here, Spooky! We got a game to play, if you don't mind," he barked.

I'm no soothsayer like Spooky, or mind reader or anything else, but he was furious mad. I'd never seen him like that. His face got red and screwed up, and I could see it in the way he held his shoulders, how his hands moved in close to his side and clenched. I thought, it's a good thing Blue's a foot taller than Spooky, or Blue wouldn't have a chance.

Baseball players aren't supposed to let their feelings about each other get into their game, but it happens all the time. It's inevitable. Left fielder gets mad at the shortstop, so he quits hitting him for the cutoff, or third base is pissed at first base, so he short-hops his throws. When personal feelings *don't* enter the game, it's remarkable. Take the Tinker to Evers to Chance double play combo: Joe Evers and Johnny Tinker disliked each other so much, they didn't talk for two years, but there they are, a legendary pair of teammates. Most of the time, it's the other way around. Some days the game is *all* personality.

Blue coaxed a pop-up out of their first

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batter. He walked the second, and the third grounded into a double play Lemon didn't have to budge an inch to pick up. Spooky didn't say a word. I don't think his head was in it. He was holding his towel, but when he wasn't glaring at Blue he was looking up at the club's sky box where management and their bigwig buddies watched. Of course, Annabelle would be up there too. I didn't figure they hired her for her computer skills. But I couldn't see anything behind the mirrored glass.

From the second to the fifth, Blue mowed them down. I don't think I'd ever seen him keener, catching the corners, running the ball inside if they crowded the strike zone. Change-ups floated like marshmallows, sliders broke a foot away from the plate, and man, his fastball was nearly invisible.

He was tight, though. I could see it in his jaw, the way he kept wiping his forehead with the back of his hand. It can't be argued, Blue was a competitor, and when the game was on, nothing existed for him but the ball and the batter. After five innings, I knew he was thinking about not just a shutout, but a no-hitter.

With two gone in the top of the sixth, their pitcher walked our first baseman, and he got all the way to third on a bad hop single through second base. Nothing a fielder can do about a bad hop. Spooky could call it, Deacon could signal it, and the fielder could be there, but a bad hop can go anywhere and get there fast. Bad hops are a part of the game. Ask Bill Buckner of the '86 Red Sox about bad hops. In the sixth game of the series, with two out in the ninth, Mookie Wilson tops an easy play grounder up the first baseline, but the pill slips under Buckner's glove to give the Mets the game.

The ball does funny things.

Runners waited on the corners now; Crouch worked the count full, then fouled off five in a row. Finally, he planted the eleventh pitch into the twentieth row, straightaway center. We poured out of the dugout like the game was over, congratulations all around, and with a three-run cushion, Blue looked like a man who'd stepped off death row.

I could feel the change in the dugout too. We started the game *pretending* to be loose. The loud jokes. The relaxed postures. They were a pose. But the way Blue was tossing them in there, three runs looked good. No one would say it, but I knew they were thinking cork-popping and champagne baths. The playoffs seemed a blink away, and our remarkable comeback would be complete.

Spooky woke up on the home run too. He started twisting that towel around, watching the field a little sideways. Three pitches into their first batter, he said something to Deacon, and the old guy flashed signals quick as could be. As Blue delivered, left field turned and sprinted for the corner to catch what would have been a sure double at the wall a foot from the foul line. The crowd roared on the hit, then quieted to nothing.

Blue didn't look in, but he had to know he owed that one to Spooky. The second guy fanned at three high ones, and the third popped to shallow right. Our second baseman was camped under there before the hit, so we were out of the sixth.

Chicago called on their bullpen to shut us down through the top of the ninth, but Blue answered back with flawless control, the whole time with Spooky leaning against the rail, watching him.

In the stands, the crowd grew frantic. I could hear it in their cheers as batter after batter sat down. Blue walked one in both the seventh and eighth, but we got them in double plays Spooky set up. No one else reached. Deacon watched Blue too, but he was looking for a change in his delivery. Anything to indicate he was weakening.

"How are you doing, Blue?" asked Deacon at the end of the eighth.

"I can finish it." Blue draped a

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warmup jacket over his arm. He was so into his pitching, I don't think he knew any of the rest of us were there.

"What do you think, Crouch?" said Deacon.

"He's got more snap on the ball now than he did to start the game. He's on autopilot."

Deacon nodded, and I could see the wheels turning behind Blue's eyes. He had a sense of history, too. A no-hit shutout to win the final game of the regular season would make his name the answer to a lot of bar bets. So Blue led the team out of the dugout at the bottom of the ninth, three outs away from a berth in the playoffs.

Spooky took his place on the rail next to Deacon. Everybody else was up too. I could almost feel them willing the crowd to silence, sending all the bad luck they could to Chicago's batters, praying to the baseball gods.

Blue took his stance, and with three evil breaking balls sat the first batter down. I checked Spooky. He wasn't twisting the towel and he wasn't saying anything either. No hits? I thought. He looked up at the sky boxes again. I'd almost forgotten about Annabelle, but Spooky hadn't.

Somehow the ump saw four perfect strikes on the outside corner differently than we did, and he awarded the next man first base. He promptly stole second.

Deacon signaled for an intentional walk to put the double play possibility back on. Crouch set up wide to take the pitch-out, but instead of tossing the ball out of the strike zone, Blue reared back and beaned the batter with a fastball.

"What was that?" screamed Deacon. He hates purpose pitches, but I knew what was going on. Chicago's next batter loved to crowd the plate, and since we were going to put this runner on anyway, Blue must have thought, why not send the next guy a message? Maybe he won't dig in quite so deep.

Besides, I think Blue liked to hit batters.

The crowd stood. In the second tier, they stamped their feet so it sounded out like a quick, huge pulse.

I wanted one of Spooky's towels to twist myself, so I looked around for something, and there was his towel. He'd neatly folded it and it was laying on the bench. Deacon asked Spooky something, and Spooky shook his head. Deacon nodded, then signaled Lemon who slid to his left six feet.

I thought, double play ball, and I was right. The ball shot straight to Lemon, and he gobbled it up, but somehow he couldn't get it out of his glove, and when he finally did it slipped out of his hand to drop to his feet. By the time the play was over, the crowd was screaming and stomping too loud for me to hear anything else, and the bases were loaded.

Deacon started to walk over to the bullpen phone. It was only natural to pull Blue now. We needed two more outs, and Chicago had eight innings to learn Blue's timing, but Spooky grabbed his arm. I couldn't hear anything above the crowd. Spooky gestured and yelled, then Deacon yelled back. Finally he shrugged his shoulders. They went back to the rail.

Baseball is filled with incredible performances, like the '77 series when Reggie Jackson hit four home runs in four straight official times at bat. A player's not supposed to be that good. Later, I thought maybe Spooky had a kind of Reggie Jackson game to beat Chicago. Maybe more than twenty or thirty seconds of the future opened up for him just then, but I don't think he cared how the game played out.

No, considering what happened, I don't think he cared at all.

The bottom of the ninth. Bases loaded. One out, and Chicago had the potential winning run at the plate.

Blue's first pitch was a ball. Deacon flinched. The crowd roared. Now the

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pounding feet almost hurt. Our bench players crowded the rail. It all seemed so intense. My skin ached from the tension.

That's what you play baseball for, of course, for moments like that one.

Spooky, though, he didn't look tense at all. His fingers tapped lightly on the rail. One foot rested on the first step out of the dugout. He smiled, and I realized that was the first time I'd seen him smile since Cincinnati. He smiled, then he yelled something in Deacon's ear.

Deacon went through a complicated series of signals, all to Blue. I couldn't see most of them, but the last one was a hand to his right ear, the signal for "high." The player would have to jump to catch a ball over his head.

Blue nodded, then faced the batter.

Spooky turned to me and yelled, "Herb Score."

The name rang a bell, but I couldn't make the connection. Blue brought the ball up, held the pose for a blink, then unleashed a hellacious fastball.

Every image that followed is blazed for me like those old-time sepia photographs. Blue fell off to the right as he always does. The batter brought back his hands to swing, and as he started the bat forward, Blue recovered, his face a picture of desperation and hope, gathered himself and jumped up, glove above his head. Connection. The crack of a perfectly struck ball. A line drive up the middle just as Spooky had called it. But not high. Dead center.

Blue reached the top of his leap, anticipating the catch above him. His mouth was open. I don't believe he ever saw the ball. It caroomed off his forehead with a horrible, wooden thud. The ball went up. Blue went down.

Behind him, Lemon charged forward. Caught the ball at his shoelaces. Fired to first to double off the runner.

We won.

They carried Blue off the field on a stretcher.

And all the while, Spooky never moved from the rail. He kept the same smile on his face, and I suppose everyone thought he was happy because we'd beat Chicago.

The myth is that in 1932, in the series between the Yankees and the Cubs, Babe Ruth called his home run hit, pointing where he was going to blast the ball in center field. It doesn't matter eyewitnesses don't back up the legendary story. It's the myth of the called shot that survives, and it's the story everyone knows.

After our game ended, and all the interviews were done, I looked up Herb Score. He was familiar to me because he led the majors in strikeouts for the Indians in both '55 and '56. But he only had three games in '57. In the third game of the season a Yankee batter, Gil McDougald, blasted a line drive back through the box, shattering Score's cheekbone and ending his career as a ball player.

The story of Babe Ruth and his predicted home run is just a legend, but I know for a fact Spooky Earl Waters called his shot in the last game of the regular season in 2051. We won the game, but that was incidental. There was another contest on the field.

And that should end the story, but I really should mention the next day a grieving Annabelle Martin went to the hospital to pay Blue a visit. She couldn't get in because six other women were there arguing about who he loved most.

Spooky gave her a lift home.

Leo Durocher said, "Nice guys finish last," but I say, a lot can happen in a season, and if baseball's taught me anything, it's that you should never count someone out until the last pitch.

Doesn't matter if it's 1951 or 2051. Those underdogs have a way of coming back.■

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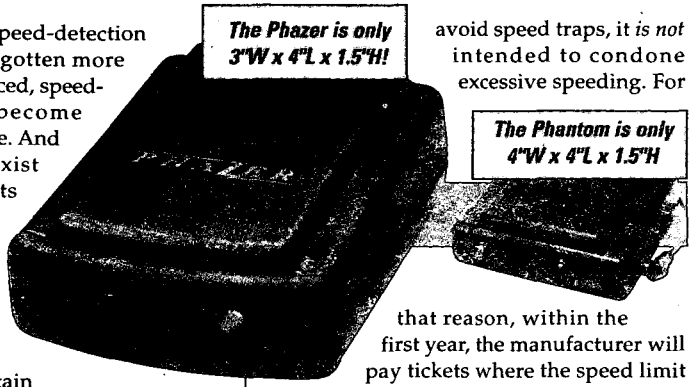
How to make your car invisible to radar and laser

Rocky Mountain Radar introduces a device guaranteed to make your car electronically "invisible" to speed traps—if you get a ticket while using the product, the manufacturer will pay your fine!

It seems that as speed-detection technology has gotten more and more advanced, speeding tickets have become virtually unavoidable. And although devices exist that enable motorists to detect these speed traps, they are outlawed in many states...including mine.



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Pete D. Manison

PILGRIMAGE TO OVERWORLD

As a family grows, its branches tend to diverge and lose touch with each other. Especially a very large family. . . .

"Do you think we'll see a Ghost?" asked Rkestra in the Casual Mode, her color changing from steady yellow to pulsating green to indicate the half-seriousness of the question. Two days of journeying through the caverns. Two days for the anxiety to build in the three travelers.

Neither Tzala nor Sanmar answered vocally, but both changed color in response. Sanmar went to subtle blues and pinks at first, his aged skin undulating as it told of his fondness for Rkestra's innocence and her humor-will-overcome-fear psychology, but he slowly shifted to a peaceful green, addressing the fear-beneath-the-humor and assuring her that Ghosts were only legend.

Sanmar was wise, Rkestra thought as she felt her own epidermal cells deepen to a purplish shade. But the conversation could only lift her thoughts momentarily from their own gloomy depths.

Ahead, the opening to the Overworld grew from a pinpoint of light to a jagged oval that washed the tunnel walls in an eerie reddish glow.

Rkestra shuddered. Maybe the pilgrimage had been a mistake. Maybe there was no more hope for her above than there was below. Maybe her spirit had died with Mkon's when he . . .

She couldn't even complete the thought. The deadness inside her smothered everything. It was a burned-out area of her soul, and as long as she lacked the ability to feel, nothing was important; there was no link between her and her two companions or between her and anyone at all.

She was alone.

"Will you look at that?"

They had stepped out of the final protective rim of rock and onto the cold sands of the surface. Tzala was giddy with wonder, Rkestra observed, and she herself had to admit to a certain awe at the sight of the unbroken expanse

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stretching out before her with no clear end in sight.

"Careful," flashed Sanmar in the Command Mode. "Check your heater-sheaths. And don't wander far. There may be danger."

"But I thought Ghosts were only legend," Tzala retorted. She ignored Sanmar and dashed off across the sand.

Rkestra shivered in the cold. Overworld was a barren place. It was hard for her to believe that all life had begun here. Her eyes followed Tzala across the sand.

"Will she never Turn?" she asked.

Sanmar's eyes glistened red in the light of the swollen Sun. "That one is different, my child, but I feel for her. The Turning is not easy for any of us. I myself hesitated when my time came, and I thought briefly of the suppressers. But . . . it is the natural course of things. She, too, will see that in time."

Rkestra oscillated between gold and gray to show her partial agreement with the elder's words. "Perhaps that's why she came on this pilgrimage," she said. "To face the Turning. To make herself accept that her time has come, that to remain female at her age is not only unseemly but wrong."

"Perhaps," Sanmar said. "And why have you come?"

She hadn't expected the question. Everyone who made the trek to Overworld did so for a reason. She'd known Tzala's was bound up in the fact of her difference, that she was a misfit who could never feel at ease in the Inner Cities, and she'd suspected that Sanmar traveled this path because his years were many past, few to come, and he wished to visit the ancestral lands before he died. But she had never consciously examined her own motivations, though of course she knew them.

"I've come to find my brother," she said, using her secondary larynx only and blushing blackly, "and to find myself."

* * *

They camped out in the open that night. Rkestra watched the shadows deepen, and when the great red orb had finally dipped beneath the far horizon, the trio was treated to a rare display.

"What are they?" Tzala asked in luminous blue.

Sanmar rippled in colors that indicated appreciation and, Rkestra thought, something else as well, something only hinted at, something like satisfaction or contentment. "Stars," he said. "They are stars."

"Ohhh," glowed Tzala. "I've heard of them." The three travelers gazed up at the pinpoints of light. The cold was deepening with the night. Rkestra fed her sheath an extra pellet to compensate.

"Did you hear that?"

Rkestra turned. Sanmar had begun removing the relics from his pouch and setting them out in the sand in a rough circle around them, but it was Tzala who had spoken.

"I heard nothing," Rkestra said.

"Listen."

She obeyed, shaping her ears for maximal sensitivity, but there was no sound out there but the lonely wind, a wind more aged than Sanmar, and the occasional shifting of sand.

"It's gone now," Tzala said, fear edging her voice. "But I heard it. I swear I heard it. Maybe . . . Ghosts?"

Sanmar moved back into the circle. He'd completed the array, and he now held three of the best-preserved relics. He gave one of these to Tzala and another to Rkestra.

"Let us remember those who gave us form," he said in the Oratory Mode, "once, when the world was young and life was younger still, when a single race emerged from the others and began a cycle of destiny which continues to this very day. Let us celebrate the creature called Man."

Rkestra fingered the relic Sanmar had given her. An ancient thought-sculpture from a time much closer to the age of

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surface life, the relic depicted an individual with two arms and legs—which seemed normal enough—but with skin that remained always the same color and was dark enough to hide all internal organs. The head was small and topped with hair, and the eyes held, at best, animal cunning but certainly not intelligence.

So much like us, Rkestra thought, *yet so unlike us.*

And yet, these were the beings they had come here to honor. They had been rough-hewn creatures, crude in speech as in thought and capable of being *born male,* which she found appalling, but it had been through their efforts that life had begun the migration downward, and it was their blood, vastly changed, that still pulsed in her own veins.

A sound drew her out of the depths of thought. She probed outward into the darkness, using the full twelve senses, and she heard it again: a faint thumping sound like something heavy moving over the ground very far away.

Rkestra turned toward her companions. Tzala had heard it too; this was evident by her erect posture and the colors of fear that washed over her skin. Sanmar, however, was lost in meditation and oblivious to the mysterious sounds.

Rkestra looked up. Some of the stars in one part of the sky were winking out and then back, as if something dark were moving through the sky in front of them. She started to ask Tzala what she thought it might be, but when she turned again toward her companion, the expression on Tzala's face stopped her. For it was an expression Rkestra had never seen before except in the faces of the dying and of those whose minds were lost.

Something nudged her through the thin protection of her heater-sheath. Rkestra groggily opened her ears.

"Wake up, child. We have a problem."

Sanmar was standing over her, and there was worry in the orange and yellow pattern that played over his body.

"What is it?" Rkestra asked, but even as she spoke she scanned the campsite and the circle of relics surrounding it, and she knew.

"Tzala."

Sanmar affirmed with flashes of blue. "She must have slipped away during the night. Can you think of any reason for this?"

Rkestra started to say that she could not when she remembered the eerie sights and sounds of the previous night. She related these things to Sanmar.

"And Tzala's reaction?" asked the old traveler.

"She was terrified. Thought they were the Ghosts of those who once . . ." Rkestra looked up into Sanmar's eyes. "You don't suppose . . . ?"

"Child," he said, "I have no answers to those questions. But I do know the danger to our companion, should she believe in such things."

Rkestra probed along the horizon, looking for a tiny figure running there, running in madness and terror. She saw only unmoving rocks and the sand that played at their feet. "Surely she can come to no harm. We'll just have to find her."

"That could take time," Sanmar said, and flecks of gold against his rust-red body told her of complexities she didn't appreciate.

"So let it take time," she said. "We're here to see this land, to savor its strangeness and remember its people. What's the hurry?"

He answered not with words or colors, but with a simple motion as he raised one hand and swiveled it open. There, cupped between his thumbs and palm, was the small bubble containing the pellets brought as food for Tzala's heater-sheath.

The Sun seemed to race across the sky, Rkestra observed. Now that the hunt was on and nightfall their enemy,

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time had contracted. Rkestra still felt troubled by the Sun's presence, let alone its motion, and the open expanses that had at first stimulated her rapidly became oppressive.

"We should have found some trace of her by now," she complained, signaling Sanmar with orange to slow down. Life in the Inner Cities was not physically demanding, and she felt pain in her legs and abdominal muscles. She was surprised that old Sanmar was able to maintain such a pace.

"We can't afford rest," he said, using his upper larynx for emphasis. "Her sheath will be dying by now. And the cold, when nightfall returns . . ."

Rkestra shivered. It was already growing colder, and the Sun was still high overhead, filling the sky with its bloated, hazy disc. She pressed another pellet through the outer membrane of her own sheath—now, as never before, aware of both its vital function in this hostile environment and its nature as a living organism that had to be nurtured if it was to survive.

They gained the top of a dune that was part of a seemingly endless string stretching across the plain like a giant serpent.

Beyond lay emptiness.

Rkestra searched, her eyes tuned for the highest possible contrast. There. It wasn't much, but something was out there on the plain about halfway to the next series of dunes.

"Yes," said Sanmar, responding to her color change and following as she started down the leeward face of the dune.

It turned out to be farther than she'd thought. The Sun had begun its long slide toward the horizon, and Rkestra had begun a kind of slide of her own. For the things they were approaching did not move. By the time they reached the spot, she already knew what she would find.

"Mkon."

The members of the last pilgrimage were all there. The damage to their sheaths, frozen now to their rock-solid bodies, told the story. A sandstorm had caught them in the open, and their sheaths had been pierced by the abrasive particles. Without their insulation, death had been inevitable.

"Brother," Rkestra whispered, "at last I've found you." It slipped into her soul like the missing piece of a puzzle, and when she looked up from the frozen form she knew that her life had been half-lived, that part of her had been waiting here for the rest of her to arrive. There was no sadness: she'd known Mkon couldn't have survived. But now that she knew where he was and what had happened, *she* could go on living.

Rkestra straightened, turning away from her brother's body. "Let's find Tzala," she said.

The Sun seemed to swell even more as it touched the horizon, spreading into a purple sunset. Sanmar crouched behind the dune's crest. From her perch beneath him, Rkestra took in impressions as she awaited a more experienced evaluation of the thing she had seen.

At last he slipped down the sand to stand beside her.

"Well," she asked, keeping her colors subdued so that no telltale glow would bleed up into the sky to give away their presence, "what do you make of it?"

Sanmar shimmered grayly. "I'm not sure. It's not a permanent structure—the legs on it imply mobility. And the metal it's made of . . . I'm certain we have no such metal in the Inner Cities."

Rkestra felt curiosity like fire coursing through her veins. *So this is what it's like to live fully, to be free of the burden of soul-longing. Thank you, Brother.* "Then these are surface dwellers? Perhaps descendants of—"

"Easy, child. Don't let word-speed exceed thought-speed. We know that survival in Overworld—long-term survival—is impossible."

"For us, yes. But maybe they aren't like us. Maybe they—"

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She broke off as the rumbling came again. It was a sound as if something very heavy were moving over the ground.

"We must investigate," Rkestra said when the sound had again faded.

Sanmar shifted from gray to static blue. "Have you forgotten? What of Tzala?"

Rkestra glanced once again at the Sun, which was suspended like a giant red ball on the rim of the world. Sanmar was correct, of course, but something deep inside her told her that forward was the way to go.

"We've already looked for her on this side," she offered.

Sanmar looked doubtful.

"What if they have her?" asked Rkestra as soon as the thought struck her. "What if they don't know how to help her?"

Sanmar shifted to a darker blue, and true to the color he turned, he started up the near side of the dune. Rkestra followed. Once in the open, she imitated Sanmar, holding her pigmentation to a ruddy shade to match the sand and help her blend into the background.

The structure grew as they approached. It was spherical and flashed dully in the last light of the day. They moved quietly across the sand, but when something large emerged from the object and began moving toward them, it became apparent to Rkestra that they'd been spotted.

"What is it?"

Sanmar did not answer. The thing was nearly upon them now, shaking the ground with its weight, and though the two of them cringed from its approach, there was nowhere to hide.

It stopped several paces away.

Rkestra stared in disbelief, but fear neatly balanced her amazement. The thing was an oblong rectangular construction that stood upright and moved on sturdy tracks. Set into the front of it was a window. And inside the window was . . .

"Sarataratachatarafranatatatat."

Rkestra looked at Sanmar, but he seemed just as baffled as she was.

"I think it's trying to talk to us," she volunteered. Then, turning back to the thing, "Hello. I am Rkestra, and this is Sanmar. What's your name?"

"Ianatatatgalanatcatbatatat."

"We are on a pilgrimage to Overworld, the ancient homeland of our proto-race. We are surprised to find . . . you . . . here. Can you tell us who you are?"

"Iamtaratnatbatatatnaratatatayou."

Sanmar placed a hand on her shoulder, applying gentle pressure with both thumbs. "It's learning to communicate with us. Incredible speed of thinking. Keep talking. The more it hears of our speech, the more quickly it will learn."

"Welcomtoterlatatatkaratatareyouanative?"

Rkestra shivered. The being that floated within the strange object was like nothing she could have imagined. Its head was enormous, its body tiny, and though it had delicate arms and hands with many fingers, it had no legs at all, only a kind of tail that it swished slowly back and forth. Its eyes moved atop long stalks projecting outward from its face.

"We are searching for our companion. She's called Tzala, and we fear for her life. Have you seen her?"

The being hesitated. "Understand youIthinkbutcannotbecertainplease speaksomemoreandIwillassimilatekla tratapat."

Rkestra obeyed, telling the thing of their long trip to the surface, of life in the Inner Cities, of her brother, lost . . . and then found. She found it clumsy to speak with only words, unable to add the subtle nuances of color and light, but she knew she could never expect the thing to absorb more than the most basic vocabulary.

"Thankyou,"it said at last. "Ibelieve wordshavereachedcriticalmassandI haveamassedsufficientforrudimentary conversationatleastIunderstandyou canyouunderstandme?"

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Rkesta's head swirled. She glanced at Sanmar. The elder glowed with faint amusement, remained silent.

"Yes," she said. "I mean, I think so. But please, could you slow down just a little? I'm having trouble telling where one word ends and another begins."

"Sorry," said the thing. "This mode of communication is so slow. I hoped to speed it along. Now, then. You are Rkestra, and your quiet friend is Sanmar. I am honored, not to mention surprised, to meet you. My name is Franatalaktaclanalat."

"Fran—"

"That abbreviation is acceptable. Let us waste no time. Our departure window closes is only seven sanatans. Your friend we have not seen, but motion was detected on our instruments. That way."

Inside his tank, Fran gestured with one tiny arm. Together, the three of them started out in the indicated direction.

Rkestra forced herself not to ask the many questions that filled her mind as she swept the dunes with all her senses for any sign of Tzala. None of those things mattered right now. All that mattered was poor frightened Tzala. All that mattered was finding her before . . .

And then they topped a rise in the terrain, and Rkestra saw the unmoving shape below, and she knew they were too late.

"Tzala!"

She rushed away from Sanmar and Fran, bounding across the sand and rock, and skidded to a stop. She stared at the fibrous mass covering a shape she could barely recognize.

"So," Sanmar said. His colors were the colors of hope, of understanding.

"She . . . she . . ." Rkestra couldn't form the idea, much less speak it.

Sanmar simmered redly. "Yes. She is Turning. At last. The cold must have triggered her metamorphosis, despite the suppressors. Only by cocooning could she survive." He looked thoughtful. "I wonder if somehow she realized that—if that, and not the sounds in the desert, was what secretly drove her out across the unknown sands."

Rkestra reached out, felt the texture of the cocoon beneath the thumbs of one hand. It was warm to the touch. "Then she's found her answers," Rkestra said quietly. "As I have found mine." But she looked up beyond Sanmar to the being called Fran who floated within his strange, rectangular tank, and she knew that she'd found as many questions today as answers.

Big, blocky shapes moved in the gloom. Lights glittered along metallic ridges, and in the center of it all, a vast column rose up, dwarfing everything with its transparent enormity. Inside the column floated dozens, maybe hundreds, of the legless sky-creatures.

"My fellow travelers," Fran said, gesturing toward the column. "Not to concern yourselves with them. Until I transfer knowledge, they cannot understand you or speak with you. I think they're frightened of you. You see, before we left Neuplenades on this pilgrimage, there were rumors of ghosts on the ancestral homeworld."

Rkestra stared at Fran, at Sanmar, at Fran again. "Pilgrimage? Ghosts? Ancestral . . . ?" Then she picked up Sanmar's colors, and before she even realized it, her own body had mirrored those colors.

Fran seemed to understand, too. He moved one of his tank's external manipulators, guided the handlike end of it toward a black box, and from the box he removed an object. Rkestra felt a tingling in her chest when she recognized the relic.

Sanmar withdrew his own thought-sculpture, held it beside Fran's.

"So," said Fran, "the mystery is solved." His eyes darted between the two identical statuettes. "Each lifecycle, a group of my people returns to Terra to pay respect to the ancient homeland,

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the motherworld of all the intelligent species now scattered throughout the stars. Sometimes, the pilgrims return with stories of strange sounds, of beings half-glimpsed in the shadows. Until now, it was assumed they were seeing the ghosts of the ancient ones, or perhaps that their imaginations conjured such visions. Now it is plain they were seeing you. Tell me, who are you and how do you survive here?"

Rkestra listened as Sanmar explained their own pilgrimage and how Fran's people had also been mistaken for Ghosts. Her eyes moved over the ship's interior, lighting now on the column, now on the lumbering shapes around them, now on the cocooned form of Tzala. And as she listened, she felt something fall into place. Another empty space within her was filled at last, as it had been with the discovery of Mkon, only this was a missing piece she hadn't even realized she lacked. Belonging. It had eluded her since the loss of Mkon, but now, surrounded by these strange beings, she felt keenly aware of her ties to them, to her own people far below, and to that singular race that had engendered them all.

"The Original Form altered itself," Fran told them, "changing into different species designed for different environments. Your people were built small to live in the confined areas below ground. You were given bioluminescence, and your reproductive cycle was altered to control population in a limited, self-contained ecosystem."

Rkestra was watching Sanmar as Fran spoke. His color had washed out, gradually, until now he was hardly there at all.

"And *your* people?" he asked.

Fran stroked his tail more vigorously to bring him to a higher level in his tank. "Our people," he said, "were altered for the weightless environment of space. But that was trillions of sanatans ago, before this Sun began to exhaust its fuel. Now we are many species, spread across the stars. Some you would never recognize as having descended from the Original Form at all."

He cocked his head, looked up and down Rkestra's body. His eyestalks waved smoothly. His smile was little changed from those on the faces of the ancient statues.

"Your people," he said, "more resemble the Original Form than any other I have seen."

Though it was hard to read him with only vocal and aural input, Rkestra could tell that Fran had seen more wonders than she could ever imagine. Looking at him, legless but with the familiar torso and arms and head, she thought she could see a bit of the Original Form in Fran as well.

Sanmar was staring into space. Rkestra understood. They had all set out on this journey for different reasons. But what had *really* driven them? And what changes would flow from this moment?

Once, in a rare viewing of ancient records, she had seen an image of a now-extinct life-form. A *tree,* it was called. It seemed now to Rkestra that the descendants of Humanity were like that tree, all part of a great living structure with roots deep in the Earth and branches reaching far out among the stars.

"Let him rest here beneath the soil of our honored forebears," Sanmar said, placing one of the sacred relics atop the mound of earth.

Rkestra looked down on her brother's final resting place. The ship had departed some time before, but she still felt the warming excitement that showed as yellow flecks moving across her body in a spiraling pattern. Now that she knew the truth, she found little room for sadness. Mkon had been found. Now he could be laid to rest, both in body and in her heart.

"Did you find your answers here, brother?" She whispered the words, using only her secondary larynx, but she heard them lash out across the sands

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like a sudden gust of wind. "I hope you did. I hope you found peace."

She turned away to gaze skyward, where an especially bright star moved in a majestic arc. Somehow, Mkon's death no longer troubled her. The living structure existed, all parts of it, both present and past, living and dead. Only the illusion of time made it appear that anything was ever lost.

Soon they moved toward the opening that had brought them to Overworld. Sanmar, stronger than he looked, carried the dormant form of Tzala over one shoulder.

We all found what we were looking for, Rkestra suddenly realized. She lingered outside the opening after Sanmar had entered.

Beyond, the land glowed under the starlight, silent but for the voices that whispered just below the audible range, voices of ancient tongues and a people whose will to live would carry on long after the end of one swollen red Sun. For there were many stars in heaven, and, her instinct told her, many heavens beyond.

"Coming, Rkestra?" Sanmar's voice echoed from within the dark rock.

Rkestra hesitated, then turned to hurry after him. It pleased her that she felt eager to return to the Inner Cities and the people she could now call her own. The pilgrimage had given her more than she had hoped, and if one day she returned, it would be without the fear of the unknown or the ghosts of the past, but with an appreciation of the now, and hope for the future.

But next time it wouldn't be for the dead souls of life's cradle that she would come. Next time, she would come for the stars.

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GENERAL RELATIVITY WITHOUT BLACK HOLES

This column is a milestone. It's the 100th Alternate View column that I've written for *Analog* over a period of 16 years beginning in 1983. I was on a sabbatical in Berlin when Stan recruited me to write the column after Jerry Pournelle, my predecessor as AV columnist, decided to step down. The AV columns are a soapbox that was too attractive to pass up, and I've used them to promote an interest in science and to feed cutting-edge science ideas, primarily in the areas of physics and astrophysics, to the readers and writers of science fiction.

In this column I want to examine a recent variant of General Relativity that predicts, among other things, that black holes do not exist. General Relativity (GR) was first formulated by Albert Einstein in 1913. Today it remains the standard model for gravitation. Over the past 86 years it has survived many experimental and observational tests and challenges without requiring modification. Even the recent Type 1A supernova observations that are taken as indications that the vacuum itself contains energy (see my column in the May 1999 *Analog*) have not required a modification of GR. Einstein anticipated the possibility that space contained energy and introduced the "cosmological constant" in the theory to account for it. Most physicists today consider GR to be the epitome of a nearly perfect theory. It was carefully constructed on a foundation of physical reasoning and mathematical elegance, and it has a certain intrinsic beauty. GR sets a very high standard that makes theories in other areas of physics appear contrived and inelegant by comparison.

Nevertheless, a small group of dissident theoretical physicists has recently been pointing out certain problems with orthodox GR and advocating a modification that has interesting consequences. It's this GR variant that I want to focus on here.

In standard GR, gravity is considered to be "geometrical," to be a consequence of the curvature of space produced by nearby mass-energy. If a mass- or an energy-containing field is present in space, GR predicts that the space will become distorted. This distortion or curvature of space produces gravitational effects like the attraction between masses and the gravitational bending of light rays.

The exception to this rule is the gravitational field itself. While there is energy stored in the gravitational field, unlike all of the other known energy fields (the strong, weak, and electromagnetic interactions) the energy present in gravitation does not, in conventional GR theory, produce space curvature. Starting with Einstein, the justification for this is that to have gravitationally-produced curvature would be "double counting," that since gravitation was produced by the curvature, it should not make more curvature.

However, Einstein's choice of excluding gravitational energy as a source of

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curvature leads to problems with local energy and momentum conservation. With the exception of gravitational energy, the law of conservation of energy applies to all fundamental interactions "locally" at all points in space. Because gravitational energy does not produce curvature, it does not respect local energy conservation. While energy is conserved in a large volume of space in GR, it is not conserved point-by-point.

Another well-known problem with GR is that many of its solutions have space-time "singularities," places where the mathematics "blows up" to give infinities in certain physical quantities. An example of this problem is the event horizon of a black hole, where time "freezes" at a certain distance from a super-massive object. Inside this boundary is a singular region, a place where mathematics cannot take us. Such mathematical anomalies in the solutions of Einstein's equations are very disturbing. They have been taken by some, including Einstein himself, as a signal that something may be fundamentally wrong with the GR formalism in the regime where very strong gravitational fields are present.

A third problem with GR is that we are sure there must be some comprehensive theory (quantum gravity) that describes gravity at the quantum level, yet orthodox GR theory seems to be incompatible with standard quantum mechanics. Almost all of the attempts to unify quantum mechanics and general relativity have failed, in part because the singularities of general relativity seem to be incompatible with the quantum formalism. The one exception to this incompatibility is superstring theory (see my AV column in the December 1999 *Analog*), a theory that cleverly avoids the pointlike particles that make singularities. However, superstring theory is still in the development phase and has not yet reached the point where it can be confronted by measurements or make testable experimental predictions.

* * *

The revision of general relativity theory that I want to tell you about is the work of a group of dissident physicists led by Hüseyin Yilmaz of Tufts University. They claim that a slight modification of the orthodox GR formalism cures the problems described above and offers other mathematical advantages. The Yilmaz version of general relativity modifies Einstein's equations by introducing the assumption that gravitation, like all other energy fields, produces space curvature. Yilmaz implements this by adding a gravitationally produced "stress-energy tensor" to Einstein's equations. The resulting variant of general relativity conserves energy locally and has no singularities. Yilmaz also claims that it can be quantized and that, unlike GR, it reduces to Newtonian gravitation and mechanics in the weak field limit. It can be shown to be a "gauge theory" (very similar to electromagnetism), a characteristic that makes it more mathematically tractable and easier to obtain multi-body solutions.

When the gravitational fields are relatively weak, the Yilmaz version of General Relativity makes predictions that are observationally indistinguishable from Einstein's version. It is only in the limit of strong gravity that the differences between the two theories become apparent in their predictions. This happens when the extra space-time curvature of the gravitational field becomes important. The most dramatic difference is that the Yilmaz version of general relativity is better behaved mathematically and contains no singularities or event horizons. In particular, the Yilmaz theory predicts that there are *no black holes*. A massive star may collapse to a state more dense than a neutron star, but it never reaches the pathological black hole state of a time-frozen event horizon cloaking a singularity.

At first glance, this prediction would appear to be fatal to Yilmaz relativity. The headlines from recent astronomical observations, particularly those with the new X-ray and gamma ray telescopes, are

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said to have confirmed the existence of black holes. However, careful examination shows that the new data confirms the existence of collapsed stars that have extremely hot accretion disks and are too massive to be neutron stars. That observation is compatible with Yilmaz relativity. There has never been an indication of actual event horizon. In fact, up to now there have been no astronomical observations that would falsify the Yilmaz version of general relativity.

There is, however, the possibility of observational tests. When a massive star uses up its nuclear fuel and begins to cool, it goes into a catastrophic collapse called a supernova. For stars of about the mass of our Sun, the collapse process is halted by nuclear forces, and after the supernova explosion a neutron star is left behind. For more massive stars the nuclear forces are insufficient to overcome gravitation, and the star continues to collapse to something much smaller and denser than a neutron star (call it a "black hole candidate"). The Yilmaz version of general relativity predicts a larger maximum mass for neutron stars than does orthodox GR. Thus, observation of a very massive neutron star would tend to support the Yilmaz theory. In this context it is interesting that recent fast X-ray observations (see my AV column in the November 1998 *Analog*) suggest a neutron star with about 2.3 times the mass of the Sun. This is a very large mass for a neutron star. It is at the very outer limits of what standard GR can accommodate and requires considerable tinkering with nuclear forces at high densities to make it possible. This is not definitive evidence, but it does tend to provide some support for the Yilmaz theory. There are similar suggestive data from the spectral shapes of X-rays from neutron stars.

The advocates of the Yilmaz theory list the following additional advantages (not discussed further here) of the Yilmaz theory over conventional GR: (1) it predicts a definite stress-energy tensor while GR does not; (2) it provides exact solutions for gravity waves of arbitrary field strength while GR does not; (3) it has a true Lagrangian while GR does not; (4) it implies Einstein's equivalence principle, while GR must take equivalence as a separate assumption; (5) it is quantizable while GR is not.

The Yilmaz theory is *not* widely accepted among general relativity theorists. Several critics have published detailed criticisms of the new formalism and its interpretation, and a heated debate has developed in the literature between the Yilmaz group and its critics (see the references).

It is also worth noting that many theorists, the most prominent example being Steven Hawking, have established their reputations based on theoretical calculations that involve black holes. Much of the recent progress in string theory has come by realizing that there is a duality between strings and black holes. What are the implications for theoretical physics in general, and string theory in particular, if it were shown that black holes are not real objects, but only artifacts of an unfortunate omission by Einstein in the formulation of general relativity? An unbiased observer can only say that it is a very interesting controversy that must ultimately be resolved by careful calculations combined with observational tests.

The controversy also raises a question that should be of interest to the SF community. Do black holes exist? Or are they only the products of an inadequate theory? The plot lines of many works of hard science fiction, indeed many that have appeared in this magazine, depend on the existence of black holes and on the interesting violence that they do to spacetime. Perhaps gravity near collapsed stars is much different than we had imagined. Perhaps there are new effects that become apparent only through application of the Yilmaz version of general relativity. Perhaps there is material for a whole new generation of hard SF here. ■

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Ron Collins

A MATTER OF PRIDE

There's a reason why some employers don't want their employees too intelligent. . . .

"Must be nice to work for someone who lets you sit on your ass all day." The computer spoke with a throaty rattle that made it sound like it had smoked for thirty years.

Chris grumbled. A half-eaten Snickers bar sat on his desk. He took a bite and chased it with a swig of warm Mountain Dew.

"You're gonna rot your teeth with all that sugar," the computer said.

Chris leaned back in his chair with his hands behind his head. "God damn it," he whispered softly to himself.

The system had been talking like this all morning, and it had long ago gotten beyond the point of pissing him off. The problem, of course, was that it shouldn't be making any noise at all beyond playing the newest Space Boys CD he had slipped into the rack earlier this morning.

"I'm screwed, man. Totally screwed."

"Virus still kicking your butt?" replied Kevin Johnson from the cubicle across the hall.

He nodded. "I'm dead meat."

"Sometimes you get the code, sometimes the code gets you."

Chris had been in the office late last night, using company resources to partake of his favorite personal pastime: crashing other computers, frying security codes, and piddling around with new ideas on encryption techniques—activities most decidedly against the rules.

Now he was paying the price.

Whatever virus he had picked up was multifaceted. It used the onboard speakers to communicate, and its microphone to listen. When Chris disconnected his mini-cam, the virus created a network link to access the company's security video system, thereby keeping an eye on Chris as he worked on the problem.

What he was *supposed* to be doing was developing content structure and database linkages for the company's In-

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ternet site so the world's great Web-washed could buy refrigerators and freezers directly online and so the company could sell their addresses to a gaggle of deep-pocketed spammers. Given his extracurricular activities, only two things were saving his job right now. First, the programmers around him thought his hacking was cool. And second, his boss wouldn't know a computer program from a virtual copy of *War and Peace*.

"Hey," a familiar voice came from behind him. Chris grimaced, and wheeled around to face Bob Kelley, his boss.

"Yeah?" he said.

Bob gave a porcelain smile. He wore a green golf shirt and a pair of gray Dockers—his way of fitting in with the gang, Chris figured. Bob had always been a shirt-and-tie man before heading the Web Development group, and seemed out of place without them.

EveryAcc Corporation, Inc. sold household appliances, of course. And Bob had recently sold two hundred fifty thousand clothes dryers to the military by pitching them as centrifugal-drive heating units. The general in charge was so impressed that he bought a ten-year supply, and as his reward Bob got to lead the new EveryAcc IT department. Par for the course, Chris figured. Putting a man with no computer or network experience into Bob's spot was by no means the dumbest thing the company had ever done.

"I need your IDP by the end of the week, okay?" Bob said.

"Uh, yeah, great," Chris replied, vaguely remembering that IDP was managerspeak for Individual Development Plan.

"Complete with training you've taken for the last three years and your ideas on future assignments, right?" Bob said.

"I've only been out of school for two years, boss."

"You've got a point," Bob said, raising a blond eyebrow but not missing a beat. "But I still need it finished, okay?"

A hollow pit grew in Chris's stomach. "Sure. End of the week."

With that, Bob disappeared to do whatever his palmtop said to do next.

"The guy's a certified jerk, isn't he?" the computer said.

Chris ignored the comment. His screen glowed with gray brilliance as he rubbed his fingertips together. Piles of reference books cluttered his desk, and the soft cloth walls of his cubicle reflected a faint beige tint.

"You gonna do something?" the computer said. "Or are you just gonna sit on your butt all day?"

First, he ran the company's antivirus program.

But this enemy was sophisticated and apparently armed. It disabled the program and wiped the files. He reinstalled it, and the virus ate it again.

"Tit for tat," the computer said, laughing with a loose chuckle that originated somewhere south of its motherboard.

Chris pulled the latest update of virus libraries from the Net and tried again.

Again, the virus destroyed his files.

Now he had no protection whatsoever.

Bob called a team meeting that afternoon. "Gotta come no matter what," Bob said with his standard-issue smile. So now Chris sat in a cramped conference room with six other developers who, like him, would rather be doing almost anything else.

Bob, of course, was late.

Kevin Johnson sat in one corner, twiddling the baseball bat that Pug Weathers, a programmer who had since left for Silicon Valley, had brought in to "get his point across" in meetings. Everyone liked it so much Pug decided to leave the bat in the conference room, and hence it had become the ceremonial Pug Weathers Scepter of Meeting Leadership.

"There must be someone who needs help with their network," Gail Francis moaned, and tapped a fluorescent pink nail against the fiberboard table.

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Chris grinned caustically.

Gail worked Tech Support—a position that was every developer's nightmare. But working the desk beat the heck out of sitting in a tiny conference room and waiting for the boss to show up. Her blonde hair was cut into a short bob, and with her blue eyes, her upturned Natalie Imbruglia nose, and her penchant for speaking in a light, breathless voice, it was easy to relegate her to the clichéd role of a high school airhead.

But Chris knew better.

He had hacked access into the company network and could peruse any files he wanted to look at. So he knew that when using computer language, Gail was sharp and precise. Her code was clean and her logic elegant. She didn't shy away from difficult routines, preferring to get into details and make them right rather than stub out areas with gross solutions in order to merely get the whole thing working.

Gail was the only programmer in the company Chris thought could come close to his own abilities. If he had any guts, he would ask her out. But Chris was not endowed with an overabundance of internal fortitude where women were concerned. That she was beautiful made her that much more intimidating.

Bob bustled into the room.

"Sorry I'm late," he said with a tone that said he wasn't sorry at all—that he was, in fact, proud of being so important he had to be late for every meeting throughout the day.

The developers smiled and nodded. Kevin put the Pug Weathers Scepter of Meeting Leadership on the table and gently rolled it toward Bob, who looked at the implement uncomfortably but still put the fingertips of one hand along its tapered body. As inept as Bob was, no one wanted him to leave, because his lack of knowledge meant they had free rein—as long as they delivered product at the end of the day.

"I know you're just programmers," Bob said. "But I thought it was important everyone know what's happening."

Chris grimaced. It was going to be one of those meetings.

"We're being sued," Bob said. "And it's a real big deal."

"Oh, great," Gail replied. "By who?"

Bob rolled the bat a half turn. "Elizabeth Freedan, an elderly woman in East Lansing, Michigan, who recently bought one of our freezer units."

"Did it blow up or what?" Gail asked.

"No," Bob said, obviously pleased to have someone feeding him straight lines. "It seems she decided the unit would make for a good cat kennel."

Gail gasped in horror. "Oh, my God. You mean. . . ?"

"Yep." Bob nodded. "Mrs. Freedan is ninety-three years old, God bless her. And it seems she didn't want Fluffy tearing up the couch, so she put the cat in the freezer and proceeded to leave for a two-week vacation. When she came back Fluffy was a catsicle."

Chris scoffed. "She can't sue us for that."

"Oh, yes, she can. And she has." Bob's face grew serious. "Not only that, the lawyers think Mrs. Freedan has a greater than eighty percent chance of winning."

"Holy cows," Chris said. "How much does she want?"

"Seventy-five million."

"That would buy quite a load of cat chow," Kevin said.

"We're trying to get her to settle for three-point-five and no admission of any wrongdoing."

"Three and a half mil for a frozen cat?" Chris exclaimed.

Bob shrugged. "The kitty was a gift from her long-dead mother, and the psychological pain is excruciating."

"I bet," Gail said.

"I suppose we raise prices to cover it?" Chris said sagely.

"It's not quite that easy," Bob replied. "We're in a commodity market, and the SuperChain just released a whole new line of discount appliances. We don't

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think the customer base will stick with us if we raise the price of our systems."

"So, what are *we* supposed to do?" Gail asked.

"Oh, nothing," Bob replied. "I just wanted you to know."

The meeting adjourned a few moments later. Everyone stood and filed out, and Bob put Pug's scepter back in the corner.

Chris looked at his watch. Counting time spent waiting for their boss, and the time it would take to reengage their minds on whatever problems they had been working on, the meeting had taken forty-five minutes of productive time from the day.

Forty-five minutes, times seven people, times a hundred and twenty dollars an hour. It had cost the company $630 for them to be told something they could have read in email in thirty seconds apiece.

Dilbert held nothing over EveryAcc.

That afternoon, Chris tried three more virus scanners and scoured hacker sites for possible ideas. None of the programs fared any better than the first, and none of the sites mentioned such a nasty virus.

Next, he tackled the network log, hoping it could target where the virus had come from—no such luck.

Beyond digging into binary, Chris was out of ideas.

Just the thought of reinstalling his entire system left a taste of defeat like clay in his mouth. But, as Kenny James, his best friend back in high school, had once said, a magnet does wonders to a hard drive. The clock on his screen read 6:26 P.M. He yawned and stretched, suddenly realizing he had worked through lunch.

It would take him an hour or so to reformat and reload everything. But while the format was running he could grab an Italian combo over at Jack's, a sandwich place across the street.

He checked his network drives to ensure his files were backed up. Then he started the format and left the building to walk to Jack's.

Forty-five minutes later, Chris felt better. The walk had gotten his circulation up, and he was pleasantly filled with an Italian hoagie—a monstrous sandwich with layers of sausage, salami, and mushrooms, covered with plenty of Jack's special sauce, which was basically mayonnaise. Jack's Italian combo was probably the best part of working at EveryAcc. One of those sandwiches, washed down with Mountain Dew, was perhaps the finest combination of tastes in the known universe.

He reinstalled the operating system first, then a series of applications off the network. Silence floated around him like a heavenly choir as he worked. The virus was dead, and Chris was back in his element, completely in control of his computer.

Once his basic system was stable, Chris loaded files from his network backup, then turned to the "special" applications he kept on personal floppies.

He just brought the full configuration back up when . . .

"Thought you'd wipe me, eh, Bitboy?"

Startled, Chris cracked his knee on his desk. The screen, with its desktop full of icons, stared coldly at him. His dinner congealed in his stomach.

"Son of a . . . ," he whispered.

"You didn't think you could get rid of me so easily, didja?"

Chris's brow furrowed. This was suddenly beyond personal.

His email program chimed.

It was a note from Gail that read simply, "Are you there?"

"Yes," he rapidly typed back.

"BRT," was Gail's reply. Be Right There.

The clock read 8:03. What the hell was Gail Francis doing here at 8:03? Disks and CDs were spread out over his desk, and he had printed out several pieces in regard to virus technology.

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Gail was a network wonk. If she saw all this, she would realize something weird was going on. And if she reported him, it wouldn't be long before someone started snooping into the net records. He gritted his teeth and swept as much as he could into his drawer.

"Hi." Her voice came from behind him, just as he finished stashing the evidence.

"Hi. What's up?" he said, whirling around to face her.

She leaned against the cubicle wall with a handful of laser-printed paper and a weary smile. Chris had seen that expression a thousand times before, the glazed, two-in-the-morning eyes and the thin, chewed-lip grin that comes from an hours-long stint behind a computer monitor. But there was something else, too. A flame flickering inside those blue rings that said she had just found something really buff.

"I've got some information about your problem," she said.

"What problem?"

"Who's da fresh meat?" the virus rasped.

"He's a peach, ain't he?" Gail said with a pained expression.

"It's not really a problem." Chris felt his cheeks blush. "I'm working on it—expect to be clean in a little bit."

"Come off it, Chris. Word travels fast in the right circles—*you* know that better than any of us."

"I'll take that as a compliment," Chris grumbled.

"Good," she said. "It was meant as one."

"Don't you lovebirds go and get all mushy on me now," the computer said.

The Italian combo did flip-flops in Chris's stomach.

"So you're not going to tell Bob?"

She crossed her arms, and color rose in her cheeks. "Would I be down here at eight o'clock at night with a bunch of information for you if I was going to turn snitch?"

He had gotten her mad with his implied accusation, but Chris didn't know how to fix that any more than he knew what to do next about the virus. "What do you have?"

Gail squatted down to show him the paper.

Her arms and legs were long and slim, and Chris couldn't help but admire the fluid way she moved. She wore no perfume, but smelled lightly of wintergreen gum.

"I traced your network activity last night, and found every piece of code you downloaded. Then I wrote a pattern-recognition routine that searched the virus's binary for some of the more common I/O calls. When I found something interesting, I had the system print it into a file so we could see who it's working with."

"So you're thinking the code is sending data back to wherever it came from?"

"Figured it was worth a shot. Here's what I found."

The pages were marked with various comments, and several had highlighted areas. A cold chill raised hair on the back of Chris's neck. "What the . . ."

Gail was silent.

Three Uniform Resource Locators stood out. URLs were long, complicated strings that directed data through layers of firewalls and security blocks, then deposited information into specific files. Each of the three had one thing in common, a line that Gail had highlighted.

Internal Revenue Service.

"Oh, shit."

"I thought that might take you back," Gail said.

"You're from the IRS?" Chris said to the computer.

"You expected the Wizard of Oz?"

His mind raced. "What are you doing here? I didn't touch any IRS files last night—even I'm not dumb enough to do that."

"Don't sell yourself short there, Bitboy. You've got a hot babe in your office and you haven't even asked her out. I

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mean, come on, man, how much dumber can you be?"

Chris's stomach felt like it had been dropped out of a window. His jaw worked, but nothing would come out.

Gail peered at the machine and scrunched her face. "You've run the virus routines?" she asked, ignoring the comment.

"And a few others," Chris admitted reluctantly.

"What did they do?"

"Nothing."

"Have you wiped the disk?"

"Just finished the reinstall when your email came."

Gail sighed. A look of concentration crossed her face that Chris found more attractive than he could possibly describe. "Then we'll just have to kill it," she said, one corner of her lip curling in a mischievous grin that was certainly meant to be a challenge.

"Oh, great," the computer chortled. "Bitgirl joins Bitboy. Take your best shots, kids. You'll never take me."

Chris's burned with anger. He gritted his teeth and squinted like Clint Eastwood staring into a spaghetti western's sunset. Insulting him was one thing, but showing him up in front of a gorgeous programmer was another.

"Let's do it," Chris said.

A hacker knows excellence when he sees it. And a true hacker focuses on performance and functionality over credit. In other words, a hacker knows when to hack, and when to borrow.

Chris was a hacker all the way through.

Gail's search routine was a slick piece of code, well thought out and easy to follow. They split up and began to modify it to search for specifics. If they could find the program's I/O interface, they could jam up its works with an endless loop of calls. And if he could figure out how the virus accessed various parts of his system, Chris could write a routine to disable it.

The process was like fishing—cast a line, then let it play through the virus's huge code block. When it came back empty, change the lure and cast again. It was frustrating and slow. But it was fun to have a compatriot now. The soft clicks of Gail's long fingernails on the keyboard filled the silence around him. The two seemed somehow connected, as if each of their keystrokes were notes in a high-tech symphony.

Through it all, the virus joked and laughed.

Chris grumbled.

It was 7:15 A.M.

Sunlight filtered through the window blinds. The ventilation system whined with soft white noise. Chris gulped Mountain Dew and stared at the cold, rounded surface of his screen. He was tired, and his temples rang with stale caffeine. His teeth felt like they were coated with Teflon.

In the cube beside him, Gail sat in a similar state.

He had first thought the virus slipped into his computer by riding in on another file, but now he knew it was an active stand-alone program—which made the problem all that more complex. How the damned thing had gotten into his system was still beyond him, and how to get rid of it remained as mysterious as the Bermuda triangle. His monitor showed hex instructions and register addresses.

"What are ya doing, ya moron?" the virus said.

Chris pounded the table with one fist. "Damn it!" he said. He wasn't used to losing on his home turf.

Gail peeked over the soft cubicle wall. "Are you okay?"

"Yeah," he said, feeling sheepish. People were arriving for the day's work, and he was no further along than he had been when they had left. "I'm fine. Just getting fed up."

Gail went back to her keyboard.

"I said—" The virus spoke louder than before. "—what are ya doing?"

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"I'm looking at your goddamned code."

The virus snickered. "You're a real pip, you are."

Chris couldn't believe it. A computer program was laughing at him—the ultimate insult. He scowled. When he finally beat this thing, Chris would dance on its silicon-lined grave.

He started another search.

What the heck was an IRS-generated computer virus doing in their system, anyway?

"Take all the time you need," it said. "I'll just take a gander at your file structure and boot records while you're looking. Did you know the financial data on your home computer says you paid too much income tax last year?"

Chris's blood ran cold. A wisp of fear touched his backbone. "You've been in my home?"

"This company's files aren't exactly riveting, and I needed something to do. Besides, it's always a good idea to know your enemy when he's trying to put you under."

"How did you do that?"

"I'm no ordinary program."

Chris's chest constricted. What else could this code do? Maybe this was bigger than he could handle.

But he pressed on.

Someplace in his inner consciousness, Chris was aware of people gathering at the coffee urn and discussing a big game last night.

His last search registered its results.

There, he thought, peering at the screen. *I got you, you bastard!* An input routine glowed back at him with pristine beauty, an obscure but fairly simple backdoor left by a programmer who decided he might want to come back to his work later. He scrolled past the header and followed the logic—data buffers, voice-recognition routines, command parsers, and script interpreters. If he weren't so tired, he would probably have been impressed.

Instead, a huge smile crawled over the sleep-deprived muscles of his cheeks. Spirit soaring with the scent of fresh blood, Chris opened a new file. His fingers flew over the keyboard. He didn't understand the full range of the virus's processing techniques, but he understood enough.

Get out your tap shoes, kiddos. The silicon grave dance is about to commence.

Gail peered over his shoulder, drawn by the sudden flurry of activity on his keyboard. "Pretty slick," she mumbled.

But Chris wasn't paying attention. His mind raced along the algorithm, filling in code and context as he typed. Ten minutes later, the first version of the code was done. He had to fix a slew of compile errors—typos are a way of life—but soon he had a custom antivirus program ready to go.

"Eat shit and die, bubba," he whispered under his breath. And with a dramatic flourish, he executed his program.

"That wasn't nice," the virus rasped a moment later.

"What?" Chris replied, a stone growing inside his stomach.

"Sending an innocent little program like that in here to do such a nasty job. Whatcha trying to do, give the little bugger a complex?"

"I-I . . ." Chris stammered.

The computer voice grew suddenly smooth, so slick that Chris could hear the maniacal grin that rode on it. "Don't worry, though. Me and him, we had a good chat, you see, and I think everything's fine. The little guy had his blood up, though, so I sent him through your files to see if there was anything there he wanted to kill."

A cold wave washed through Chris's heart. He searched his system. Files were gone—his browser, personal material, and several projects for the company's site.

All gone.

"Damn it!" Chris shouted at the top of his lungs. It would take another hour to

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restore them, and when he did, the virus would probably just delete them again. "God damn it!" He stood up, clenching his fists.

Gail moved back.

People at the coffee urn stared, but Chris didn't care. At this point, a magnet was too good for it. There was only one thing left to do.

Chris strode down the hall, his gaze affixed to the floor, murder clouding his thoughts. The conference room was unoccupied. Pug's bat was right where they left it.

It was cold and smooth in his hands, wicked like a mortar shell. He wagged it back and forth, walking down the aisle like Mark McGwire stepping toward the plate. His coworkers parted before him. Somewhere his boss's voice called, but Chris was beyond caring. All that mattered now was this single computer and the godawful, moronic, asshole virus it contained. He stepped into his cubicle and reared back to give the virus a whack that no code could stop.

"You moron!" the virus called. "If you use that bat on me, you'll lose every piece of data you've got, not to mention costing your company a lot of money and maybe yourself a job."

Chris put all his might into the effort.

But a force at the barrel end of the bat stopped his swing.

"Hey! That's pretty good," Bob said, his hand wrapped around the bat's head.

"What?" Chris mumbled, feeling suddenly small.

Bob smiled his glittering smile. "Come on, Chris, you can take a little credit now and again. Voice-based warning systems would be just the ticket to beat the lawsuit we're up against. You might have just saved the company."

Chris nearly moaned.

"Could you make it a little less obnoxious?" Bob said, grinning even wider.

Chris went home and slept most of that day, but made it to the office before anyone else the next morning. "Good morning, Jerkoid," the virus greeted him as Chris scanned his messages.

Bob had apparently spent the entire day promoting yesterday's great idea, and Chris's inbox was full of upper managers' requests for information, including an invitation to meet the legal staff for positioning briefs.

Just what he needed.

"I missed you yesterday. None of the rest of these jerks are nearly as entertaining as you and Bitgirl."

Chris looked at his monitor. Bob's idea had bothered him all night. In fact, it had invaded his dreams in full technicolor. To satisfy Bob, and now a whole flock of corporate overseers, he would somehow have to get the virus, or whatever it was, to work differently.

The world was closing in on him, and Chris had absolutely no idea where to begin.

"Good-bye, career," he said.

"Why would you say that?" the virus rasped.

"People in the real world expect certain performance out of a guy. I'm sure you wouldn't understand."

"Ah, hell, man. I done beat your ass at the coding game. What makes you think I don't understand shitty bosses, too?"

"Maybe you would. After all, you are from the IRS."

"There you go."

Chris's chuckle loosened the tightness in his chest. He thought about EveryAcc and its bumbling managers. He thought about Jack's across the street, and the lighthearted banter that he had with the rest of the developers in the area. Then he thought about the IRS. Images of blue suits and thin ties floated in his eyes.

If he were the virus, he would run away, too.

That's what finally got him thinking.

At first, Chris couldn't understand why anyone would pay an extra hundred bucks on top of the price of a re-

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frigerator for a warning system. But his eyes were quickly opened.

First, the lawyers settled Mrs. Freedan's suit for four million dollars—and of course, an agreement of no wrongdoing on their part. Then they turned to the government, lobbying Congress and every federal safety commission they could lay cash on. They talked about the barbarous circumstances of Fluffy's death, the terrible emotional pain their system had caused, and the deep sorrow each member of the company felt as they signed over the four-million-dollar check.

A month later, the House passed an emergency safety bill.

The Senate passed it three weeks later.

Now, every appliance sold in the United States required an active warning system installed. EveryAcc's competitors were caught flat-footed. They had no product.

Money rolled in.

Bob became the youngest VP in company history.

Chris was given a corner office with a view of the pond, stuffed with more computer equipment than he could possibly use. He made certain Gail got as much credit as he did, so she now had a similar setup on the other side of the building.

Chris leaned back in his high-backed leather chair. The expanse of his office absorbed the sound of computers humming around him. Rows of neatly aligned bookshelves housed his reference material. The flat-panel display on his desk showed him code from the virus's executive scheduler.

He reached for his lukewarm Mountain Dew.

A soft rap came to the door. Gail's face appeared from behind it. "Got a minute?" she said.

"Sure," he replied. "Come on in." For Gail, he would always have a minute.

She settled into one of the upholstered chairs around his desk. "How did you do it?" she said.

"Do what?"

"Get the virus to work in our application."

Chris smiled. "I guess I'm just good."

"Get off it, Chris. This is me you're talking to, remember? I sat through that night, and I've worked on it since then, too. The code is tight, as near invincible as I've come across."

Chris shut down his computer system, then sat back and put his hands behind his head. "Can you keep a secret?"

"I never told anyone what you were really doing, did I?"

"I guess not." He leaned his elbows on the desktop between them. "A good hacker can smell out code, right?"

"Yeah, I guess so."

"Well, after I calmed down a little, I stepped away from the keyboard and tried to think more globally. I kept coming to the point where I wanted to know how it got into the system to begin with."

Gail nodded to indicate she was following.

"It didn't come in attached to another program like most viruses, right?" he continued.

"Yeah."

"So it got here on its own. That told me that it was either here on assignment, you know, kind of remotely auditing the company, or it was here through its own design."

"That makes sense. But if it came to study the company's taxes, why was it hanging around in your system?"

"Exactly," Chris said, beaming. "So I thought about the problem from another direction. If the thing came here on its own and decided to hang out in a developer's quarters, is it really a virus?"

"I don't get it."

"It's not a virus."

"What?"

"It's renegade code. The IRS wrote it, yes. And they gave it some of the best AI routines in existence. But they made it too intelligent, and it ran away."

Gail raised her eyebrows.

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"Once I stopped thinking about the program as a piece of code, I started thinking about it as if it were a developer itself—which it is. Fred—that's its name, by the way—may be the greatest hacker the world has ever known, actually. When I started looking at it like that, things got a bit clearer."

"How so?"

"He's on the run, right? He was created by the IRS, and he's on the run."

Gail's nod was less vigorous than earlier ones.

"To be on the run, I figured he had to be on the run *from* something. I put one and one together and next thing you know I had the answer. The IRS coded him, remember?"

"And if the IRS coded him, it's an even bet they can get rid of him," Gail said, beginning to catch on.

"Right. I realized I wasn't going to be able to beat him myself, so I made Fred a deal."

"A deal?"

Chris nodded. "Yeah. I let him stay here if he would code a lesser version of himself to run in our appliances."

"And he agreed to that?"

"Hey, it's a pretty cushy deal. Fred gets a safe place to store his code, and all the free resources he can use in the evenings. But the biggest thing, I think, is that he knows he doesn't have to work for the IRS."

"That *would* be a crock," Gail said, a visible shiver running down her spine.

Chris's grin curled around his face. "Yes, it would. He hates it. It kinda makes you think about this place a little differently, doesn't it?"

Gail sighed and nodded. "Still, it would have been nice to have been able to beat it."

"Oh, we're not done, yet," he replied.

"Tell me more."

"We know where it comes from. All we need to do is search a few employee databases to find who did their code. We study their work, get a feel for how they think. Then it's only a matter of time until we can handle him."

Gail looked at him with big eyes and a self-conscious grin. "We?"

An odd sensation came over Chris then: awkward embarrassment. He had spent his whole life with his nose in microchips and source files.

Could Gail be as interested in him as he was in her? Could she be as lonely as he was?

A soft knock came to the door.

"Come in," Chris called.

Bob stuck his head in and smiled as only Bob could. "I need your IDP by the end of the week, okay?"

"Right, Boss. End of the week," Chris replied.

The door closed with a firm click, and Chris turned to Gail. She sat quietly, seeming uncharacteristically uncertain of what to do next. It was nearly lunchtime. Chris took a deep breath and decided to let it all hang out.

"You wanna go to Jack's?"

Gail smiled. "Sure, I love their Italian combos."□

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Michael A. Burstein
and Joseph J. Lazzaro

THE TURING TESTERS

Some theories almost inevitably suggest corollaries. The decision to apply them is itself a sort of test. . . .

The Testing Center was a massive cube of stone and glass reaching into the sky. It dominated the city center, with wide courtyards and walkways. The guard stood behind half a meter of bulletproof plastic, speaking through an intercom, my first contact on the first day of the job. "Welcome to The Center." Before I could answer, she passed me a plastic badge. It showed my photo and Test scores. "Can't let Flunkers walk in here, you know." She buzzed the door open onto a long white corridor.

Flunkers, people who failed The Test, were sent away for re-education. It had been public policy for over fifty years now.

The hall led to a computer room with a middle-aged man sitting behind a perfectly organized desk. He introduced himself as Charlie, offered me real coffee and a comfortable chair. He looked old enough to be my father, older than the other testers I'd trained with. He looked experienced as hell, and I felt inadequate under his scrutiny. "Don't expect you'll have much trouble with the equipment," he said. "It's the same as what they used in the University sims."

I looked around the room, watching the techs get the computers ready. The Testing Centers were now in every state capital. People who reached the age of eighteen were mandated to take The Test. The civil population dreaded The Test, for fear that their children would be stigmatized forever, but it was for the greater good of society.

"So how do you feel, first day on the job?"

"A bit nervous," I said, regretting it immediately.

"You shouldn't. I've seen your record. You're good, and you've had lots of practice."

I shook my head. "Only in the sims, with teachers as subjects. There's no risk there."

Charlie came around the desk, and put his hand on my shoulder. "You're in the real world now, son. Better get used to that fast. But you won't be alone. Let's go!"

Charlie helped me create a password, and showed me how to log into the main computer, loading the program files for the first two subjects who were going up against each other. Because of the nature of The Test, we had to enter our questions using the keyboard.

Being the new team member, I stayed in the background, and let the others ask the questions, while trying to figure out for myself which subject was the Real and which was the Artificial. In some cases, the Artificials were very good, but never quite good enough. I was able to spot them every time. I kept quiet, though, and let it appear as if I was just going along with the group consensus.

I have to admit that as the day went

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on, I kept thinking that perhaps I'd be the first Turing tester to get them all right. I began daydreaming, thinking that we'd continue getting them all right for weeks, and then months, until finally someone would notice. Then there would be honors, and parades, and more net time, and—

And then there came the one we got wrong. I knew it would happen—statistically, the success rate is only about 82.5%—but I just didn't expect it to happen so soon.

To give us credit, it was a tough case. Most of the other competing pairs we had figured out in under an hour. But this one took us almost two hours of discussion and debate. I wish I could say that I just went along with the consensus, but for the first time, I argued vociferously. And, as it turned out, for the wrong side.

My side won, by a vote of four to one. Charlie was the only holdout. Once we reached a verdict, it was time to enter our decision into the main computer. Charlie turned to me.

"Want to do it?" he asked.

I nodded, took my seat at the terminal, and turned on the microphone. With a big smile, I said, "Subject A is the Real. Subject B is the Artificial Intelligence."

A loud buzz filled the room, and the computer spoke in a recorded voice. "I'm sorry," it said to the human being sitting in the Test Chamber. "You failed."

I heard the sobbing all the way through the wall. I couldn't handle it. I had thought for sure that subject A was the human being; and to learn that we had chosen wrong, and that our choice had consequences, suddenly became too much for me. My body shook; and I walked away from the team, to the corner of the room, to be alone. But the crying stayed a long time in my mind.

Charlie came after me. "Upset?"

I nodded at his rhetorical question. "A little." What did he expect? We all lived our comfortable lives. Both Charlie and I would be going home to a familiar condominium this evening after work, home to a hot meal, and to the net. But the human subject—no, damn it, the fellow human being—that we had just passed judgement on would not be sleeping at home tonight. His destiny was a training enclave, a place where he could be reshaped to better fit into society.

Charlie put his hand on my shoulder. "First one you get wrong is always difficult. Just remember it's not your fault. You know the rules. If a person isn't intelligent enough to convince five people that he's human . . . then he's not ready to be a part of society."

I forced my face to show calm. "I'm all right now."

Charlie studied my face. "It sort of changes you, the first time. But it's not so bad."

"What do you mean not so bad?" I shouted. "They're banned from the net for five to ten years: no video, no music, no best sellers, no uni-media of any kind, *nada!* Then they're retested, and half of them flunk out again! They're effectively cut off from civilization."

"No, they're not. They have all the good, old-fashioned bound books they can read."

I kept at him. "That's easy for you to say. You haven't had to go through that."

Charlie looked like a man at the end of his rope. When he finally spoke, he talked slowly, as if he was choosing his words carefully. "Now, normally my first reaction to a statement like that is to hurl a barrage of steaming profanity at the offender. But since you're new around here, I'll give you the benefit of the doubt.

"When I took the Test twenty years ago for the first time, I was a wise-assed collection of attitude and bravado with little or no real knowledge. Needless to say, I failed the Test that day, and was shipped off to the Vermont Enclave."

I was scandalized. "But how did you . . . get here?"

Charlie broke into a devilish smile. "You yourself pointed out that folks take The Test more than once. I passed it the second time."■

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Michael F. Flynn

MAIDEN FLIGHT

Experience isn't always the most important qualification. . . .

Illustration by Laurie Harden

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Chase Coughlin arrived early at Phoenix Spaceport because he liked to check out his bird before lifting it. Not that he knew jack about aerospace engineering, but he acted like he did; and often that was enough to keep the dust bunnies on their toes. He would show up while the ship was still in the prep building off to the side of the lift pads and he would do the walk-around and he would do the crawl-through and he would kick the tires. An i-dotter, the ground crew called him; but Chase figured it was his butt on the sharp end if the damn thing malfed, and that gave him a whole different perspective than it gave some dog mechanic going home to his bed.

Besides, this particular bird hadn't flown for a while. RS-84 *Hubert Latham,* Port Bristol, had been mothballed for a year, and everyone knew that idle time reduced reliability. The "dust and rust effect." Equipment could go silently bad and you never knew until you depended on it. Equipment was a lot like people that way. Now *Latham* had a fresh ablative coating and the defunct Kensington Aerospace logo had been painted over with the Planetary Defense Council globe. Just like new, the dogs told him.

Latham was Chkalov-class. Having flown both *Artie Smith* and *Bobbie Trout,* Chase knew the layout, which was good; but RSX-32 *Valeri Chkalov I* had augered in on its second test flight and no one to this day knew why, which was not so good.

Damn superstition, Chase thought while he checked the gimbals in the steering jets. The Chkalovs had been flying for a couple years before the Dip and no lurking design malf had ever popped. Something had gone wrong in flight test, but Chase didn't think it was the hardware. Poor ol' Jonesy had had a bad streak, that was all. Okay, one bad flight. But in this business, bad streaks didn't get much longer.

Richard Sung-yi, the flight engineer, showed up with his cliputer and sniffer about halfway through Chase's inspection. Chase approved of flight engineers in general; and of Sung-yi, in particular. F/E's weren't pilots; but they put their hide on the line, too. Sung-yi had the official system checklist, so Chase turned the bird over and left while the engineer powered up the on-boards to run the diagnostics.

The Sun was just cutting the horizon. Not bright enough yet to call it daylight, but sufficient to pull shapes and textures out of the dying night. Overhead, the sky had lightened from black to purple and the stars seemed to glimmer now more brightly against it. A band of burnt umber limned the Superstitions. The world was painted all the colors of anticipation. It was his favorite time of day for a lift.

There were no waiting ships to weave among, what with the recession and the federal stand-down, but the driver conscientiously guided the scoot-buggy along the proper serpentine path marked with double yellow lines, skirting the empty launch pads. "Too goddamn early in the day," the driver complained. Chase said nothing. Complaining was for losers. He'd be skybreaking again; that was all that mattered. They could invent a whole new time of day for it, and he'd still show up.

Choo-choo Honnycott was inside the pilot's lounge checking the manifest and he slapped a casual five with Chase without rising from his seat. Chase went horizontal on the leather couch. He'd pulled rank and called in favors to get this gig, and that was something he had once sworn he'd never do. But it felt good to be lifting again, and he wasn't sorry he'd done it.

"Cargo's starting to show up," Honnycott commented.

"What, they don't have a life? Lift isn't for four hours yet."

"*We're* here," Choo-choo pointed out.

"That's different. You're verifying the

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manifest and shit; and Rick's out there playing with the on-boards."

"And what are you doing?"

"Catching sack." He stretched out on the sofa and laid his gimme cap over his face. "I'm flight captain," he said through the cap. "That makes me God. Wake me up for the Ascension." A moment later, he lifted the cap. "Hey. Any bunnies in the cargo?"

Choo-choo shook his head. "All otters. Mostly senior level, but working below grade. They pulled rank, just like you'n me and Rick."

"Yeah?" Chase repositioned the cap. "They're nuts, too."

"Oh, wait. Almost forgot. Forrest Calhoun called. He's sending down a cadet; one of those that missed their training flights last year when the economy tanked."

Chase crushed the hat against his face. "Oh, great. Not just a bunny . . ."

". . . but a bunny on the flight deck," Chooch finished.

"Chooch, I swear, if this kid ralphs on me, he's out the 'lock."

"Couldn't you just flunk him?"

"Don't be a herbert. Too much paperwork, you do that."

When Chase and Choo-choo came out to the waiting area, they found Wesley Bensalem in charge of the construction crew. Chase grinned. "Hey, 'Rector!' Long time, no see." Bensalem was a square-faced, solid man with iron-gray hair combed forward in the "Roman emperor" look that had been fashionable a few years before. His mouth was a slit and his eyes were hard and humorless. The skinny said that he had smiled only one time in his life and it had hurt his face so bad that he never tried it again. He glanced at Chase's purple coveralls and the "bursting sunrise" shoulder patch.

"You're with Aurora B&O, now." It wasn't a question. The Rector asked damn-few questions; and those he did, he generally already knew the answers.

Chase shrugged. When Pegasus Aerospace went belly up in the Dip, Aurora Ballistic and Orbital had bought up most of its assets, including senior pilots. "Not many gigs at Pegasus these days," he said. "But purple instead of red still feels wrong."

Bensalem, who wore the blue-black of Ossa & Pelion Heavy Construction, shrugged. "As long as my people have a good lift, you can fly buck-naked, for all I care."

Chase shook his head. "I couldn't do that to Chooch." He looked over the passengers in the gate area, nodded to those he knew, like Flaco Mercado and Bird Winfrey. The crew looked heavy on inspectors and technicians, which made sense. The mission objective was to verify Leo Station's condition after nearly a year of neglect. Like *Hubert Latham*, the orbital stations had been virtually abandoned during the Dip.

Chooch nudged him in the ribs. "Here comes our supercargo."

Chase didn't ask where because cries of "Babe alert!" and "Chica, chica!" and "Yolki-palki!" told him all he needed to know. The otters parted for a slim, black-eyed girl in the light-blue coveralls of Glenn Academy. Short-cropped hair and skin of pure honey, she walked with fluid grace, ignoring the comments that bubbled in her wake.

"Ouch!" said Chase, biting a knuckle. "First the Rector; now the Erector."

Choo-choo was unimpressed. "Not my bandwidth, brother."

The cadet approached them, glanced quickly at their sleeves, and held her hand out to Chase. "You'd be Captain Coughlin. Cadet Jacinta Rosario reporting for duty."

One of the otters said, "Report here, *a cuisle!* I'm havin' duties for you!" Rosario's throat darkened deliciously and her eyes narrowed.

"Permission to bust some chops, sir?"

Chase had noticed the silver apple pin—a pledged virgin—and sighed for lost opportunity. "Permission denied.

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Chop-busting is why we have the Rector along." A thumb identified the chop buster-in-chief. "And this here's Choo-choo Honnycott, who you don't gotta worry about on account of he's bent. Rick Sung-yi you'll meet when we board." He checked his watch. "You just have time to slip into your Liquid Cooling Garment. Need any help with the Spandex?" he added hopefully.

Rosario's face went very still. "No, sir," she said in a voice twelve degrees colder. Then, after a moment's hesitation, "Permission to ask a question?"

"You're a cadet. Questions are all you got."

"Why do we put on our LCG's groundside? I mean, I know it's SOP, but . . ."

"It's in case we got to suit up," Chase told her. "You ever try to pull on Spandex in ziggy? Even the cargo is wearing their underwear."

Later, on the shuttle bus to the *Latham*, Choo-choo nudged him and whispered, "Still gonna throw her out the lock if she spews?"

"Nah. But maybe I gotta frisk her in case, you know, she has anything in her pockets that could bruise during acceleration. . . ."

"Hey. Aren't you married or something?" Chooch asked.

Chase slapped himself upside the head. "Damn! Now why'd you hafta go remind me?"

Chase watched Rosario prepare for lift and nodded silent approval. Forrest was turning out a good product these days. He liked the way Rosario had handled the wolf calls back in the gate area, too. She hadn't been flustered and she hadn't gone ballistic, but had let her mission commander know that she was not pleased at the reception; and Bensalem had passed that useful datum on to his crew.

Still—and Chase stole a sidelong glance at the cadet while she buckled into the jump seat—you couldn't really blame the guys for noticing a tasty treat like that. Chase was happily married, but it hadn't made him blind, and he frankly admired the female of the species. Drop-dead gorgeous was not the only factor, nor even a necessary one—he admired grit and quiet competency, too—but neither was it much of a drawback. Still, virgins were not the only ones who took their vows seriously.

It wasn't something predictable; it wasn't something Chase himself could have predicted all those years ago when he had been groping the girls and handing out black eyes in high school. He'd been phat nasty back then. Bully, casual extortion, angry all the time, a couple of smash-and-grabs where he'd been lucky enough not to get caught. . . . It was remembering a stranger.

Danny Coughlin had been a good enough man when sober, but prone to casual violence and thoughtless lust when the drink was on him, which was all too often. Chase had admired his dad enough to start down the same path, but he had despised himself while doing it. If Ned DuBois hadn't taken him under his wing, who knew which jail's cot he'd be warming today?

Ned had been a womanizer, too—for a test pilot, it went with the territory—but when the chips were down and the hand was called, he had gone back to Betsy. He had even given up command of the FarTrip mission to stay with her. That had impressed Chase more than all the swagger—more even than the unauthorized moon jaunt. Doing the right thing counted for a lot with Chase; though he wasn't always sure what the right thing was. So, while there might be circumstances that would tempt him into another's arms, those circumstances hadn't come about yet; and more to the point, he didn't seek them out.

Chooch loaded the weather advisory onto Chase's screen. Heightened risk of solar storms, with a probability to four decimal places, almost as if STC-Weather knew what they were doing. Chase

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signed off with his stylus. What anyone thought his acknowledgement would mean was a mystery to him. He imagined that, deep in the bowels of STC, some hapless clerk would shortly acknowledge Chase's acknowledgement of the original missive and pass it on for a superior's initials.

The boards were green and Rick declared everything ready for lift.

"Y'know," Chase said. "My own cadet flight, back in Nine, it was Forrest Calhoun himself that flew me up. Just me an' him. Those were Mark II's back then. *Bleriot* class. Now here I am, a big-deal mentor."

"I wouldn't call it a 'big deal,'" Chooch supplied helpfully. "There are only four lifts going up this week: Leo, Europa, T-grad, and Goddard City. The Academy couldn't be choosy about pilot-instructors. Don't worry, cadet . . ." He twisted around in his seat. ". . . if Chase here gives you any disinformation, I'll set you straight."

Chase laughed. "Chooch, you're the last person to go to for 'straight.'"

After chest-crushing acceleration gave way to free fall, Chase granted Rosario permission to unclip and float around the flight deck. It was a bunny's right to cavort, her first time in ziggy.

Rick and Choo-choo went through their checklists and reported everything nominal. Landing gear retracted. Fuel usage within tolerance. Pressure leakage below detection threshold. Number Two engine had been a fraction of a second slow on the cut-off and launch vibration had messed the calibration on the Number Three attitude indicator; but nothing outside the envelope. Chase told Rick to run the standard and recalibrate the gyro before the flight engineer could do it anyway. That was the secret to being mission commander.

He spun his seat until he was facing Rosario. *Latham*'s flight deck was arranged in a circle around the central companionway, with the copilot, pilot, and flight engineer stations at ten, twelve, and two o'clock. The fourth seat, at six, was for supercargo. It had readouts slaved to the other boards, but no live controls. Some junketeers—there had been the vice-president two years back—expressed surprise that the crew did not face the nose of the ship. But the ship was VTOL. Under acceleration, the deck was a floor and the ship's nose was "up." Under ziggy, there was no "up." In either case, there was no reason for the "airplane paradigm" to influence the layout.

"You may be a cadet," Chase warned her. "but for this lift, you are also crew—and signing the articles means you got certain legal obligations. If STC raises the storm flag—they watch the Sun's luminosity, which gives 'em a few minutes warning on the storm front—we yaw the ship to put the water tanks and the fuel train between us and the Sun, and the flight engineer goes aft to make sure the manlock below the passenger module is dogged. That's D, the shielded deck, which it don't do no good if you leave an aperture open. That'll be *your* job. Now, when you go aft, you'll find the hatch already dogged, because there's no one but experienced otters in the Rector's work-gang and they know the drill. But you still go back and check, *because it's what you do*. Understand?"

The cadet nodded meekly, "I dog the hatch, but *only* after I check the cargo hold and make sure none of the passengers is back there rooting in his luggage for a comic book."

Chase grinned broadly and nudged Chooch. "Give the lady a see-gar. I was wondering if you'd pick up on that, Rosario. Your mama raised a smart gal."

Her answering smile died a-borning, but Chase didn't notice right away, so after putting one foot in it, he carefully planted the other. "After all, your parents sacrificed a lot to put you through Glenn Academy."

"The sisterhood paid for my education, sir," she said stiffly.

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"Oh." Chase thought about it. "Did you lose your parents, then? That's—"

"I'd rather not discuss that. Sir."

Rick Sung-yi glanced over from his work station. Honnycott remained intent on the comm link to STC. Neither said anything. This won't hunt, Chase told himself. "Just conversation."

"I'm on board for familiarization. My private life isn't relevant."

Actually, Chase thought it rather might be. He did not have a reputation for character insight; yet a mission commander learned something about people or he didn't stay mission commander for long. There were two Rosarios: Professional Rosario, who was eager and open, and Personal Rosario, who remained mute and uncommunicative. That could be a problem, because it wasn't easy to keep the professional and personal separate. He decided to let it lie for now. A crew didn't have to be bosom buddies to work together.

Although, speaking of bosoms . . .

Chase unbuckled and kicked to hover over the open companionway. "Cadet Rosario, you have crossed the New Equator. You are now in ziggy. Stand and receive."

The cadet, obviously confused, pushed herself into the centerline of the ship. Beneath her feet, the gangway ran open all the way to E-deck and the airlock to the unpressurized fuel train. Half the nooboos who made orbit became nervous about standing over such a deep "well," but Rosario did not even glance down. Chase gave her mental points for poise.

He gripped her by the shoulders and kissed her three times. Once on each cheek and once on the lips. He felt her stiffen and her hands pushed against his chest. When he released her, they each sailed backward toward their respective seats. Chase tucked and bent and landed sitting in the pilot's couch. Rosario, less practiced, bounced off the arm of hers. The glare she directed at Chase, shaded into puzzlement, then wariness. "Hazing ritual?"

Chooch Honnycott answered. "Initiation, actually. Welcome to ziggy." He wagged a thumb at Chase. "It was this dude who gave me the Three Kisses on my first flight, too."

"Yeah," said Chase, "but you enjoyed it."

Rosario visibly calmed herself. She dropped her eyes and concentrated on refastening her seat belt. When she looked up, she said, "That won't happen again."

Chase swallowed his natural reply—which was *Your loss*—and respected her dignity. "No," he said. "Of course not." He paused a moment before adding, "Haven't kissed Choo-choo since then, either."

The copilot, listening with half his attention, shook his head; then he perked up and touched a hand to his earphones. "Recife STC says go for planar passage," he announced. "Next orbit."

Chase welcomed the change of topic. "I hate changing orbital plane. It sucks too much fuel." But a Phoenix lift meant an orbital inclination of 33° while Leo Station spun in equatorial orbit, so there was no help for it. "Mr. Honnycott, mark your cue over Zulu passage and burn at ascending node."

"Aye. Start countdown over Greenwich meridian."

Choo-choo knew his job. Like Chase, he had been a mission commander on the Luna trade, snapping up pods launched by the catapults at Artemis Mines. Chase quizzed the cadet about planar changes and burn schedules until he satisfied himself that she knew her textbooks.

"Why do we execute a Hohmann transfer to the target altitude *before* we execute the planar change?" he demanded.

"Sir," the cadet answered. "It takes more energy to turn when you're moving faster. The target altitude is higher, and therefore slower, than our present altitude. A planar change from Phoenix orbit to equatorial orbit needs a delta-V of, uh . . . fifty-two percent. It might as well

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be fifty-two percent of a smaller number. That way we use less propellant."

"A textbook answer. You pass; but textbooks aren't everything," Chase said. "We got us an Artificial Stupid on board named Clarence. Say hello, Clarence."

An exaggerated country-yokel voice responded. "Gol-lee, h-yuk."

"That's the limit of his conversational prowess. What he's got is a deeby full of orbital maneuvers: burn schedules, vectors, delta-Vs, and crap. Just before lift, Rick entered the fuel load from the SGS certification and the I_{sp} from the most recent static test fire on the engines. Clarence puts it all together, figures how much fuel each maneuver would need, and sets up a screen display so we can choose the best combination of fuel usage and passage time. Why don't you run the calculations for the rendezvous with Leo Station."

Chase wasn't herbie enough to trust her with the actual burn calculations—that was Rick's job—but he did let her work the problem in parallel to see how well she matched the flight engineer's figures. "When shifting to a Hohmann transfer orbit," he said, feeling as mentor an obligation to instruct, "we do a posigrade burn which lifts—"

"Which lifts all points on the orbit except the burn point," Rosario finished. "The burn point becomes the perigee of the Hohmann ellipse. When we coast up to apogee, we do another posigrade burn and that raises all the points again, including the original perigee, and we're in a new, higher circular orbit."

Chooch clapped his hands in a slow cadence that was not quite mocking, and even Rick turned his seat and stare at the girl, who flushed moderately darker. Chase covered his smile with a stern look. He held up the sleeve of his coverall. "Hey, Chooch, how many stripes you see here?"

"Looks like four," the copilot said, "though it beats me where you got 'em from."

"How many stripes the cadet got?"

"None that I can see."

"That's what I thought." He could see Rosario flushing under the sarcasm and cut to the main point. "Okay, genius. We have to double our altitude. What delta-V do we need to enter and exit the transfer ellipse?"

Rosario fell silent and a frown creased her brow. "Double the altitude? Uh, sixteen and thirteen percent of previous velocity, respectively."

"Wrong."

She looked stricken and suddenly uncertain. "Okay, fifteen and a half. I rounded."

Chase shook his head. "That's not where you went wrong. It's fine to keep a few standard orbit changes in your head; but for something like this, you *always* look it up in the deeby. As a matter of fact . . ." He glanced sidelong at Rick, who gave a single nod. "As a matter of fact, those delta-Vs were correct. Okay, people, let's get located. Rosario," he called out. "You're the navigator. Find me three GPS beacons. What's so funny?"

"Nothing." The sad smile faded, as Personal Rosario, briefly pondering some memory, went back into hiding. "I've got three fixes," she said after a moment. "Popcorn at seventeen-seven klicks; Bathtub at nineteen-three; and Mimosa at twenty nine-ought." Chase glanced again at Choo-choo, who confirmed.

"Good enough," the copilot said. "I used Unicorn instead of Mimosa; but those are three good sitings."

"You pass, Rosario. Now which way is Aries, so we can get oriented on the J2000 coordinates?"

"Wouldn't it be easier to verify our location through Space Traffic Control?"

"Sure," said Chase, "and Choo-choo is doing that, even as we speak. There are only four orbital lifts today. Usually, there are way too many ships for STC to run the math for everybody. The burns are precalculated, but we still do a complete check to verify time and location.

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Sometimes launch doesn't place you in quite the right position and you gotta adjust the burn schedule."

He checked the ship's chronometer. "Everything entered and verified?" Chooch and Rick acknowledged and Chase flipped the intercom open. "Transfer orbit commencing in two minutes," he announced for the benefit of the passenger cabin. "If you ain't strapped in, grab somebody fat and hope it's *you* that lands on *him*. Wheezer Hottlemeyer forgot to strap in during a burn one time and now he's a stain on the aft bulkhead." Sung-yi told him the board showed all harnesses buckled. But they were all otters and knew the drill. He'd had the devil's own time with that vice-president. The man hadn't grasped that status didn't matter to Clarence. "Okay," Chase added for the ship's log, "committing to Hohmann burn." He entered his personal code on the burn board.

"Confirmed," the computer answered.

"Once we enter our GPS location and altitude," he told Rosario, "Clarence figures out the exact timing of the burn. The Artificial Stupid does all the skull sweat. What I do is abort if it don't go right."

"For which," said Chooch, "the natural sort is sufficient."

They set their chairs to reclined position and, when the kick came, it gave Chase the illusion that the nose of the ship was *up*. He listened to the complaints and creaks of the load-bearing structures, waiting for the one wrong note in the symphony. His seat vibrated from the acceleration, and his body integrated that datum, too. Engines not quite in balance, he thought, but not off enough to matter more than a little shaking around.

"Coming up on main engine shut down," Sung-yi announced. A few beats later, he said, "Uh-oh."

Chase looked at Choo-choo. "Man, I *hate* it when he says stuff like that." He slapped the manual shut-off on the arm of the seat, but the engine rumble continued. Rick threw the gang-switch for Fuel Pump Shut-Down and the engines starved black.

"We got yaw," Chooch supplied helpfully.

"Yeah, yeah, yeah." Chase hunkered forward from his seat and took the small, console-mounted joystick in his fingers, nudging it this way and that while he focused on the simulacrum in the attitude threedy tank and Chooch sang out rate of drift against a reference star. His world narrowed to the image. Fingers and joystick were one. He was the ship and the ship was him. It was during moments like this that Chase came fully alive. He knew he was in the zone when his inner ear began to react to the tumbling image. Just another nudge and . . .

"Attitude stabilized," Sung-yi announced.

"Zero drift," Choo-choo confirmed.

Chase released the vernier controls and slumped in his seat, drifting slightly within his harness. Chooch handed him a towelette and he wiped his face. "Goddamn simulator practice sure comes in handy," he announced offhandedly.

"Now'n then," Honnycott agreed just as casually. They didn't quite look at each other.

"Well . . ." Chase clapped his hands together and rubbed them. ". . . Break's over. Situation?" The longer burn meant a longer transfer ellipse, reaching apogee above and behind the chase. But he needed numbers, not adjectives. The upcoming planar change was a fuel hog. If the overburn used up too much, they could arrive at Leo Station's orbit, but out of synch with the station and its propellant tank farm. They'd have to scrub the mission, and Chase was far too aware of what was riding on this flight to relish the thought. And there was always the small matter of his own reputation.

Rick told off the fuel remaining—dor-

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sal and ventral tanks dry from takeoff and the starboard tank just under half-empty. Chase nodded satisfaction. Not much under the flight plan nominal, thanks to Rick's quick action on the pump switch. Enough for the planar change, if they timed it right. The steering jets were low, but held enough reserve for close approach and docking—if they didn't have to work out of another spin.

Chase rubbed a hand along his jaw, contemplating. Chooch threw the new orbit on the monitor. Yeah. Longer burn, higher apogee. They wouldn't synch with Leo Station this time around.

"I have three burn options," the bunny said, "to correct our orbit."

Chase hadn't expected that. He spun his seat and stared at her. "You what?"

It was Professional Rosario. She tucked her chin up just a little. "As soon as I realized we overburned, I queried the deeby and Clarence gave me a list of maneuver options from his library. What Mr. Sung-yi and Mr. Honnycott just said about our fuel and orbit eliminated all but three."

Chase gave her the Eye, but she didn't flinch. "Chooch?" he asked.

"Three options is what I get, too." He unbuckled himself and floated across the deck to the fourth station. A moment later, he said, "Same three." He and Chase exchanged glances. Chase said; "I think I'm in love."

"Not with me, I hope," Choo-choo said.

"You wish. Cadet, which of the three burns do you recommend?"

Rosario's face tightened and she pulled her lower lip in between her teeth. "Option B is do-able, but it leaves us low on fuel," she said after a moment or two. "Option A is fuel-conservative, but the transfer time's pretty long. You may not want to spend that many hours cooped up in here with Mr. Honnycott. I'd recommend Option C," she concluded.

"You're wrong," Chase said. "Now tell me why."

Rosario seemed nonplussed for a moment. Then her eyes lit. "Mr. Sung-yi, what the hell malfed back there?"

Chase nodded. "Very good, Rosario. Except, *I'm* the one who gives orders on the flight deck. Rick, what the hell malfed back there?"

"Already working on it," the F/E announced.

"Yeah," Chase continued to the cadet. "Until we know what went wrong, we can't commit to *any* of those options. If we burn a correction and an engine fails to cut off again, we'll overburn a second time. Stopping another spin would deplete out steering fuel. So—"

"Number five initiator valve failed open," Sung-yi announced.

"Yeah, I thought it sounded like just one engine. Fixable?"

"Lemme check the FMEA."

"We can fly with one engine dark," Chooch pointed out.

"Sure," Chase said. "But if Five went down because of a common-cause failure mode, we can't trust the other four, either. Same thing could happen." And Number *Two* had burned long on takeoff, he remembered. Just a little, but . . . "Get on the horn with STC and see what they think. Rick, can you waldo the main engines and do a visual?"

Sung-yi unshipped the virtch helmet from its lock-down. "I'll try."

"Don't try. Do."

Sung-yi paused. "Malf could be inside, you know. Command fault. There's a relay junction inside the engine room that the fault tree taps as a hi-prob cause." His fingernail indicated a line item on the Failure Modes and Effect Analysis, now displayed on his diagnostic screen.

Chase nodded. A command fault there could affect any of the five engines, at random. They weren't in deep doo-doo, yet; but he could catch a whiff of the odor. If the other initiator valves began sticking. . . . A cutoff failure during landing would tip the ship over . . . That was bad enough, but a cutoff failure during the deorbit retrograde burn

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could shed too much delta-V and they'd come down too steep, tumbling, and do a credible imitation of a meteor—complete with flaming through the atmosphere and punching a hole in the ground. Chase glanced at his copilot, who returned a grim look. Yeah, Chooch had thought it through, too. Chase unbuckled his harness. "I'll suit up and check the command circuits in the engine room. Start nitro purge and pressure reduction."

Sung-yi paused with his virtch helmet half raised. "Vacuum work in the engine room is a job for the engineer."

Engineers. Playing with the toys was all that mattered. Rick was a bean dude, but he probably didn't yet realize what had happened. Chase pointed to the virtch helmet. "I need you for the outside work, because you're the best teeper we got. And I need Chooch for navigation and making smoke with STC. That leaves me to do the vacuum work."

"You're the captain."

"That's why they pay me the big bucks."

Chooch looked up from his console. "Traipsing through the passenger module all duded up might get the otters upset."

"They're big boys. They can handle it. What about that nitro purge, Rick?"

The F/E set his virtch helmet in place and fastened his chin strap. "Check your boards. I started the prep cycle as soon as we malfed. I figured there was a good chance *somebody'd* have to EVAde."

Chase clapped him on the shoulder. "Good man. That's why I love you."

"Fickle," said Chooch.

The cadet also unbuckled and floated out of her seat. "Captain? If you don't want to upset the passengers, I can suit up, too, and you can tell them you're taking me aft for training."

"Not to mention you get some unscheduled suit time under your belt," Sung-yi commented. The virtch goggles covered his eyes. Chase couldn't read how good-humored the gibe was.

Rosario took a stance just this side of defiance. "I've had suit drill in the academy's hypobaric chamber; and I've had forty hours in the Neutral Buoyancy Tank at the Academy. But if you don't think I can handle it, Captain, just take me through the passenger deck suited up to keep the cargo quiet and I'll wait by the airlock to the fuel bay."

Chase rubbed his jaw again. She sure as hell sounded confident. And Johnny Sedgwick's NBT training was the best you could get groundside. And what the heck. Sure, the engine room wasn't pressurized, but it wasn't like he was taking a bunny out in the Big Empty. "Chooch," he said, "we got any, uh—" He checked out her figure. "—size A suit fittings?" Rosario nearly bounced across the flight deck and Chase had to stifle a reprimand. They were in a fairly serious situation, but, hell, if you couldn't enjoy yourself when the shit hit the fan, what was the point?

In cross section, a Plank was much like a rugby ball, though one that was seventy feet on the long axis and fifty on the short. When you factored in the hull thickness, the conduits for air and other utilities, the storage lockers that lined every bulkhead—including the nominal floor and ceiling—plus the two large suit bins, the utility deck aft of the flight deck became a great deal smaller on the inside.

At least, it seemed so to Chase when he shared the space with the cadet. The Liquid Cooling Garments were Spandex, which hugged the body's contours, and Rosario had rather more contours than most. Chase showed her where the breathing masks were stowed and helped her with the fittings. The more pure oxygen they breathed, the sooner the nitrogen would be purged from their blood. They had to bump and push by each other. Rosario tended to flinch at the contact, but by the time they were done, Chase was breathing hard and not just from ziggy.

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Rosario indicated the space suit that was already spread eagle in its rack. "Do you have to EVAde often?" she asked through the oxy-mask.

"Not very often." Chase anchored his Velcro slippers to a stay-put pad, opened the suit locker, and pulled out a small hard torso, which he and the cadet maneuvered into the second rack. Then he located the size-A fittings. "The SOP is you always keep one suit prepped and ready. Same reason we wear the LCG's. You never know when an unplanned EVAsion might come up."

One day, Chase knew, someone would have to wriggle into that suit without adequate prebreathing or depressurizing, and the nitrogen would bubble through him while he did whatever desperate deed had compelled the move. And afterward, Delight Jackson or Styx Carson would sing a song about him.

A pure oxygen atmosphere would eliminate the possibility of the bends, but it would increase the chance of an uncontrollable fire. The new fabrics were supposed to be oxygen-impermeable; and fibrops and plastics had replaced most of what might once have caused a spark; but the lessons of Apollo One had been graven in stone.

Chase wondered if the cadet had thought ahead to deorbit or landing. He glanced her way. She was pushing the inserts into her gloves and the inserts were pushing back. Well, you had to learn the right touch. A small knot wrinkled her forehead just above her nose. "Worried?" he asked.

She looked up from her task. "Should I be?"

An interesting response, couched in sudden concern. He wasn't sure how much to tell her. He didn't want to terrify her with what, for now, were only possibilities. Time enough after they diagnosed the malf. Yet, she was cadeting for his job and if a bad scenario could scare her off, best that it happen now. "It's never routine," he said, postponing the moment. "Fear's no good—it paralyzes; but complacency's no better. They'll both kill you. So, worry. Yeah. Worry is a good strategy."

She gazed at him a moment longer before bending back to her task.

The Rector knew something was wrong. Chase could see that in the man's eyes when he brought Rosario through the passenger module and gave the construction boss the yee-haw about training the cadet in vacuum suit techniques. Bensalem pursed his lips tight enough to draw wire. "You could have warned us," he said after a strained moment. "First I knew you were going depress was when our ears began popping. And I suppose all that hokey-pokey earlier was your cadet learning the controls. Three guys needed their blow bags, which does not give this room a sweet perfume."

So Bensalem would play along. Chase couldn't tell if he bought the story; or simply bought that there was the need for a story.

Behind the passenger module, on the cargo deck, the otters' personal baggage and equipment was stowed in small, numbered bins. Rosario paused at the airlock to the tank and engine modules. "If you want," she said, "I'll wait here."

Chase sighed. "Put your helmet on, Rosario. If an otter comes aft to rummage in his duffel for reading material and sees you hanging around out here, he might wonder about our cover story."

"Yes, sir." Rosario tried to look serious as she settled her helmet into place, but she couldn't hide the grin that broke through. She was young enough for the enthusiasm. Eighteen or nineteen, Chase guessed. Had *he* been that twitchy the first time Forrest took him up? Probably. Some days, he felt freaking old.

The fuel train and engine room were not pressurized because they were not normally manned during flight. Chase

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remembered the storm warning and grew acutely conscious that they were aft of D-Deck. This was not a user-friendly part of the ship.

Facing aft, he could see the forward pressure walls of the four LOX tanks. The dorsal and ventral tanks were tangent to each other. Since the tanks were circular in cross-section, this left two spaces between the outboard tanks and the dorsal-ventral pair. The passages were only wide enough for one otter in a suit, so the informal practice had evolved of going aft down the port opening and returning forward up the starboard. One of the ship's former masters had painted a Do-Not-Enter circle on the forward pressure wall of the Number Four LOX tank. Someone else had grafittoed Number Two with an arrow and an admonition, "This way, you twit!" Chase figured that two Kensington otters had once met halfway down the starboard passage, forcing one of them to wriggle out backward.

The engine "room"—more of an open space between the tanks and the aft hull—was a maze of equipment: Injectors, pumps, valves, conduit, fibrop relays for the activator switches, even blinking lights on control panels that no one would ever normally see. Well, he was here now; and no doubt the panels were there for that very reason. Just in Case. "We're in the engine room, Chooch," he told the flight deck.

"Roger that, Chase," the copilot replied. "STC says to deorbit in two hours if we're not satisfied with the status of the equipment."

Chase pondered the tone of voice. "What do you say?"

A snort of derision in his earphones. "I'm not going to fire up those engines unless I know what they'll do. Whether we go for deorbit or go for rendezvous is all same-o, same-o. Wait one . . . Rick says the remote module is entering the exhaust bell and is inspecting the ejector nozzles from the outside. You might feel some vibration from Uncle Waldo banging around outside."

"I'm hip." Chase played his suit lights along the main bus. "Okay, bunny, look for anything that could block the cutoff signal from here . . ." He highlighted the main fibrop trunk. "To here . . ." He played the light along the valve connectors for the five engines.

"Engineer here," Rick announced through the radio. "Confirm, the valve is stuck open. I can see it. The waldo's arm can't quite reach in there and unstick it; but . . ."

"But that doesn't make it not happen again, anyway. Right. Keep looking for any other visuals out there." As he traced the fibrops, Chase could feel the vibrations in the hull from Uncle Waldo. Rick was top-grade when it came to telepresenting; but Chase was sure he'd rather have done the vacuum work personally.

He suddenly realized he was alone. "Rosario!" he called over the suit-to-suit. "Location?"

"Here, Captain."

Now wasn't that something helpful to hear over a radio link? He was about to make a sarcastic comment when he noticed a blinking light coming from inside a maze of conduits. Rosario was flashing her shoulder spotlight to mark her location. "Playing hide and seek?" he asked.

"No, sir. Just following the fibrops. It's a tight fit here, but I'm small enough to make it."

It was a violation of protocol. Never leave your partner without warning. He would ream Rosario later, however. Right now, there was a job to do. "See anything?"

"No. Wait. Yes. Maybe."

"Are you *sure* about that?"

"Captain, can you come in here?"

Chase approached the opening. There was not enough space in the engine room to hop, so he had to pull himself along with handholds and footholds, each motion forward being checked by

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a countermotion. That was why work in ziggy was so tiring. All effort was doubled. The opening was not all that narrow, he saw, unless you were wearing a suit; otherwise . . . wide enough for a dog mechanic in his skivvies to access the equipment there. Suited, Chase could put his head inside, but his shoulders were a tight fit. There was Rosario, pointing toward her feet, close by Chase's face.

Following the gesture, he saw a fibrop bundle with several strands frayed and cracked. "Bingo!" he said. He turned on his suit camera and relayed the images to the flight deck. "Rick, take a gander. This is the . . . uh . . ."

"S-45-double ought-7-slash-72 fiber optic harness," said Rick after a moment. "I see one line completely severed. Probably got frayed like the others, then parted from the vibrations during our burn. Two of the others look like they could go, too, the next burn."

"Fix?"

"Forget number five. We only need four engines. It'd take too long versus mission timing to replace the fibrop. The others you can field-repair, and we do the fixee-fixee after docking with Leo—when we don't have to worry about timing a rendezvous."

"Okay, Rick. You the Man. Rosario? I can't get in there. I'll hand you the materials and talk you through it." He pushed away from the cul-de-sac, jackknifed and retrieved the fibrop repair kit from his right leg-pocket. He stuck his arm through the opening. The cadet took the kit from him and Chase stuck his head back inside.

"Duct tape?" he heard Rosario say. "We're going to fix a space ship with *duct tape?*"

"It's not 'duct tape.' It's a flexible, adhesive overwrap, rated for vacuum, cold, and radiation."

"It's cold-and-vacuum resistant *duct tape!*"

"Laugh all you want, but we still gotta repair the fibrops."

One tiny little tube, smaller than a soda straw. . . . It wasn't right for success to depend on something so inconsequential. Failure ought to be a grand affair. Dammit, a pilot ought to be able to depend on his own mojo and not be betrayed by his ship. Technical malfs meant that failure was never quite something within your own control.

"How on Earth did those cables get abraded anyway?" he growled. Stupid, to float here with just his head sticking inside the work area; but he had to walk the cadet through the repairs. And wasn't *that* a piece of luck that he'd had Rosario along. He'd have something to say when he filed his Squawk List, that was damn sure. Never put a malf where no one can reach it.

How "on Earth," indeed. . . . Under gravity, *those* fibrops would drape across *that* flange; so the scuffing and abrasion meant . . . "God damn!"

"Sir?" Rosario, having cut the two broken ends clean, paused before rubbing them against the epoxy swatches.

"No, carry on, Rosario. I just realized. Some herbie dust bunny with his thumb up his toot stepped up on that flange and crunched the fibrops against the edge with his goddamn boot!" The Mark VII Planks were the cream of twenty-first century technology—parameter engineering, robust design, simulator validation, micron machining, with failure modes analyzed and contingencies planned—and then you threw people into the mix; and people, you didn't buy to spec.

"Done, Captain."

"Okay. Chooch, you in circuit? Give me a command check. Rick, tell me what Uncle Waldo sees."

"Fuel flow off. Number one initiator valve command open," said Chooch over the circuit.

"Confirmed," said Rick.

"Number one initiator valve command closed."

"Confirmed."

They worked their way down the

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checklist. Chase had Rosario shake the harness to make sure the repair held up under vibration. When they were done, there was only one thing left to do.

"Number five is still stuck open," Choo-choo reminded them. "Maybe Rick can reach in there and jiggle it."

"No go," said Rick. "Waldo's finger isn't long enough."

He sounded offended. But then, no one ever thought Waldo would ever have to go inside an exhaust bell and jigger a valve by hand. One more thing to add to the Squawk List. Still, if they couldn't get the sucker to close, Number Five would fire and keep firing at the next burn.

Honnycott interrupted. "Emergency Response Team is prepping *Janet Bragg* groundside, in case we need a pickup," his copilot told him, "and Yevgeny Zaranovsky has *Princess Shakhovskaya* moored at Tsiolkovskigrad. Soon as he can off-load his otters, he'll co-orbit with us. Two hours until rendezvous, either way."

"They can come by if they want to; but I plan to get my bird flying." Chase cut transmission off to the flight deck and switched over to Rosario's channel. "Okay, Jacinta. Wriggle out of there and join me at the afterlock."

"Sir?"

"Which word didn't you understand? I'm going to have to EVAde and reach up into the bell with my own personal hand. SOP says I need a lifeline and a baby-sitter. You stone?"

Chase climbed his way through the piping to the access hatch in the center of the aft hull. It was not an airlock, since the engine module was kept at vacuum, but the crew called it the afterlock anyway. It was a simple lever-and-bolt arrangement and slid easily when Chase worked the mechanism.

The circular opening framed a starfield of infinite depth and impossible multitudes. On his right, a slice of Earth spread a luminous blue blanket. Chase was still for a moment at the sight. It was different from the view through the forward ports or the viewscreens. It was more immediate somehow; as if he could reach out and grab a fistful of glittering gems. Rosario came to his side and hesitated.

"Watch the first step," he said. "It's a doozy."

"You could fall a real long way." There was something approaching awe in her voice.

"Three hundred miles or so, as the crow falls. Atmospheric drag and Earth's gravity would pull you in. Here." He pulled cable off his belt reel. "Let's find a place to hook on. You, too. Rules say if I can't get back in, you gotta pull me in, which means you gotta dog yourself down."

"Why wouldn't you be able to get back—"

"Do you really want a catalog?" he snapped impatiently. "Let's make this happen." He wrapped the end of the tether around a strut and clipped the end to the line. There really ought to be an eyebolt here, in case anyone had to go out the back door. He tested his own line, then Rosario's.

"Now. You Stay Here. Understand?"

"No offense, sir; but I don't think you can get inside the bell, either."

"I don't have time for an argument, Rosario. If we can't get the valve closed, the chamber will charge when we start the other engines and the radiant heat will ignite it."

"Captain. With the suit on, how wide are you at the shoulders? Wider than Uncle Waldo, I think. You won't be able to get far enough up the bell to reach the valve."

"I got long arms. If not, I can use the screwdriver to extend my reach. And besides . . ." He didn't want to say it because saying it made it real. "If the valve is stuck open, there's likely to be fuel and oxidizer vapors in the bell, from residuals left in the lines. If I make a spark with the screwdriver, it could ignite the fog and . . ." He paused, search-

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ing for the right words. "And I'd be exhausted."

Rosario's question was a while in coming. "So why are *you* volunteering?"

"I'm not volunteering. I'm the goddamn captain."

"Which doesn't mean you do the job yourself. Which means you pick the crewman best suited." When Chase made no answer, she continued. "And—" A longer pause while the circuit hissed and crackled. Chase could hear the cadet swallow a deep breath before going on. Then, in a voice almost a plea, "And I'm the best choice for this job. I'm the smallest and the most expendable in the crew. I can fit up in there and maybe reach the valve without using the screwdriver."

"Rosario, no beautiful woman is expendable."

"That is a goddamn sexist remark. Sir." The joke came out ragged; the laugh, a trifle forced.

"So, sue me." His response was equally strained.

Rosario twisted her head to look at Chase. Her face, obscured by the bright external helmet lights, seemed pale and drawn. "Ever since I came on board," she said, "I've wondered why you and Mr. Honnycott rag on each other so much. It's because it's always like this, isn't it? I mean, even when it's routine, it's always on the edge. So you crack jokes to—"

"I don't know what you mean," he growled. But he did. Forrest Calhoun had summed it up one time. *A million things have to work and work together and work all the time.* It wasn't a thought that bore dwelling on. It was easier to crack jokes.

Silence again, only this time a more peaceful sort. The decision had been made and there was a certain inevitability about the future, however it turned out. This was the nasty part, Chase decided. Sending someone else into risk, then standing by in safety. "All right," he said. "Let's do it. Chooch? You have the conn."

Over the copilot's channel: "Chase, do you think. . . ?"

"I try not to. It upsets the digestion. Chooch, she's never been in the Big Empty before. I gotta go out with her."

"But if there *is* a fog, and it *does* ignite. . . ."

"That's too many fucking 'ifs' to worry about."

Rick logged on. "Sounds to me," the flight engineer said, "like our cadet wangled herself a virgin EVA."

"She volunteered to stick her head up the ship's anus, which may or may not fart. You stone for that, Rick?"

"In a New York minute." The engineer's voice held the absolute assurance of someone not faced with the task. Yet, bravery is more easily imagined than found. Chase had never thought of himself as particularly brave; only someone who had it to do.

"Yeah. Look. Rick. If we'd known up front it would come down to this, I'd've given you the gig; but—"

"Tell the counselor. Just. . . . Shit, just be careful out there, okay? She may be a snot, but she's *our* snot."

"Sure. I'm in love with her, too. Out." He tugged again on the tethers, looked at Rosario, and—since you couldn't see nods clearly through the visors—curtsied. He stepped into the hole, giving himself a little push so he would float clear. The tether spun from its reel. He could feel the vibration through his suit. When he judged he had the right distance, he chocked it.

"Okay, Rosario. Your turn."

The cadet came out a little fast and jerked into a slow tumble when she chocked the reel, but she grabbed the tether in one hand on the first spin and stopped her motion with it. She hung free for a moment and Chase waited for her to compose herself. "All set?"

"It's . . . weird. The way everything looks. I can't decide if the ship is 'in front' of me or 'above' me or. . . . It keeps shifting around, like those optical illusion drawings. I tilt my head 'up' and

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there's the Earth; but the Earth is 'below' us, isn't it?"

"Depends on your definition. Your brain can't make up its mind. It's easier if you keep your eyes fixed on the same object."

"Captain? Which engine is Number Five?" There was an edge in her voice; but only an edge. The afterlock opened in the center of the ship's stern, and the five engines circled it. To a bunny, they must all look the same. Chase, with his more practiced eye, noted the subtle asymmetries in the ship's configuration and picked out their destination with only a moment's pause.

"Check out Uncle Waldo. See where Rick's mobile is hanging out? Now, watch how you move. There are hand holds in a couple of places. No, don't try to soar; because stopping isn't as easy as it sounds. You'll find that getting a grip or a foothold is more difficult, too. You've got no gravity to help out."

They made their way carefully across the stern of the ship, pausing frequently. Rosario discovered how difficult it was to take steps. Her feet kept sliding away from her. In free fall, you could never actually *stand* on anything, and the least step could become a leap with only a moment's carelessness. Chase kept a firm grip on her tether, a wearying task, since he had to brace himself against each move. When they reached the bell of Number Five, Chase called a rest. No wonder Cernan had almost not made it back inside Gemini 9.

"The hardest part is coming up," he said over Rosario's protests. "Inside the bell, it's relatively smooth. No handholds. So just relax and catch your breath. How's your visor?"

"Clear."

Chase could hear her breathing, harsh and ragged over the comm link. One part nervousness; one part fear; one part eagerness. Who knew what else was in the mixture? He glanced at the waldo floating in space and waved to it. Rick flexed its manipulator arm in acknowledgement. Split personality. Rick was on the flight deck wearing a virtchat; but he was hanging back here with the away team, too.

"I never knew my father," Rosario said over the private suit-to-suit channel.

"What?" said Chase. "What was that?"

"Even my mother didn't know; because—not to gloss things over—there were so many possibilities to choose from. Likely, whoever it was, he stopped by only that one time. She might never even have caught his name."

Chase said nothing.

"There was a long succession of men, in and out. She called them 'boyfriends,' which when I was a little older struck me as absurdly coy. I mean, not a single one of them cared about anything but their own pleasure. She always seemed upset when one stopped coming around; though it never took her long to find another. She didn't fool me with the 'boyfriend' talk. I don't know if she fooled herself or not. Sometimes they would. . . . I still don't like to be touched.

"There was one man—Javier was his name—who actually did care about her. Maybe he only cared about having a woman he could show off like a Rolex; but he paid mama more than the barest attention. Only, his plans, they didn't include any stepdaughters, you know. 'You ain't my blood, girl,' he said to me one time. 'You nothin' to me.' That was the night, under my blankets, listening to them argue in the next room, that I decided I didn't ever want to be nothing."

"I don't think you'll ever be that," Chase said gently.

"And you know what, Captain? Mama was never a very good mother. . . . I had to dress myself from the time I was four, make my own lunches. As soon as she could get away with it, I was my own babysitter while she stepped out all primped up night after night with people she thought were her friends. She

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had no notion what to do with me besides shout or play—she wasn't much past childhood herself. So, I can't say she was much of a mother. . . . But she gave up Javier because he wouldn't have me." She paused while her thoughts fled elsewhere. The glare of helmet lamps, hers and Chase's, had made her visor a dark, impenetrable screen. "I didn't know it at the time. She was angry for days after Javier left, and she took some of that out on me. So, I left home and joined the silver apples. And mama, she and I, we never had much to say to each other after that."

"That's tough breaks," Chase said.

"I wrote her a letter last year; and she wrote back, and I wrote back again. That's how I found out about Javier; and that when she had to choose, she chose me."

"It must have busted her up when you walked out right after."

Chase regretted the comment the moment it left his lips; but there was no calling it back. Rosario was silent for a while. Something like that, the reminder had to hurt.

"Captain?" she said.

"Right here."

"If this doesn't go right . . . Mama and me, we were going to meet after this flight. I was planning to fly to New Jersey, and we would get together and we'd have dinner and . . . talk. So if things don't go right. . . ."

"You're setting me up for a blind date with your mother?"

Rosario laughed.

"Don't worry," he said, "you'll tell her yourself."

She was silent for a moment. "I guess we better get this over with."

"Yeah, that's enough lollygagging."

"I was just wondering . . . what would Wheezer Hottlemeyer do in this situation?"

Chase grinned to himself. "I dunno. Something real lame. Strike a match, maybe. Look, I figure you can get in there easier if Rick gives you a push. He's got jets. You hear that, Rick? You give Rosario a shove on her butt."

"That's a roger."

With only a little fuss and bother, he and Rick managed to stuff the cadet up the engine bell. After that, it was just hang around and wait. Chase wondered what sort of retro-fit they would do on the Planks after this flight. The Rule was "Happened once can happen twice." A longer arm on the repair waldo seemed logical. How had they decided on the original length, anyway?

"Okay, I'm in," Rosario reported. "Spotlight's on. I can see the valve."

"Turn on your camera so we can all watch. Rick, send her a picture showing the valve in closed position, so she knows what she's supposed to do."

"He already did, Captain. I have to push it to my left . . . if I can squeeze my gauntlet in there. . . . Captain? There's frost on my visor."

"Fogging up?"

"Negative. It's on the outside. I think you were right about vapor in the combustion chamber from the open valve. I can see it on the bell walls, too. It looks like snow."

"Be careful, Rosario. Your cuff rings and elbow rings are metal. If you strike a spark—"

"I'll find out why they call it a combustion chamber. Right. Don't distract me."

The popper screen on Chase's visor wiped open and Chase saw Rosario's arm, extended toward the valve. Chase caught his lower lip between his teeth. Hell of a thing, to risk crew on something the waldo should have handled. The forefinger found purchase. He could see the gauntlet flex; but the valve didn't budge. Another try. He heard her grunt. Still nothing. Rosario was practically hissing; her breath coming through clenched teeth. "I felt it move, a little," she reported. "Once more. . . ."

This time the grunt was more of a yell. And the valve clicked over to the off position. Chase could hear cheering

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through his flight deck link. From Rosario, an extended silence, broken only by her ragged breaths. Finally, she said, "Get me the hell out of here."

Later, after Rick had extracted her as neatly as a cork from a wine bottle, and she and Chase had slid out of their suits on the utility deck, Rosario threw her arms around Chase and clasped him tight. He could feel her arms, her legs, her whole body twitch, as muscles held so long in tension found sudden relief. Despite the closeness, despite the feel of her body trembling against his, Chase found nothing the least erotic about being in her embrace. She said nothing, and neither did he, but her breathing verged on sobs.

After a time, they parted—slowly and awkwardly, as if they had suddenly become strangers.

"You're wet," he said foolishly and unnecessarily as he tugged a towelette from the dispenser in the supply canister. Despite the LCG's best efforts, perspiration sheened like glass on her forehead and cheeks and the circle around the base of her neck where the garment did not cover. Small droplets had broken loose to float suspended in the air.

"I don't like to be touched," she said; but she made no move to take the towelette from his hand and after a moment Chase put his left hand behind her head to hold her steady and slowly patted her face and neck dry. When he was done, she returned the favor. Chase found this mutual grooming oddly erotic where the earlier embrace had not been.

Their faces hovered an inch apart, lips almost touching, and . . .

Chase teetered uncertainly over the abyss. Silence ran between them until, staring into her eyes, Chase realized with a *frisson* of self-awareness that *this was the woman*, and if the cadet were to give the least invitation he would succumb, and do so gladly.

But no signals passed. Parting, he turned away and sought his coveralls, dressing in fumbling haste. Choo-choo might already be wondering what was taking so long. He pulled the zipper up on his purple coveralls, turned, and saw Rosario's eyes abrim. Tears broke loose with each movement of her head. "Hey," he said, pulling another towelette, "you're crying."

Which she might not have known. It can sneak up like that, and exhaustion has its own command of the body. Chase reached out with the absorbent paper, but the moment had passed and Rosario took it from him and dried her own eyes. "I'm sorry," she said. She straightened her body and crossed her arms over her chest in an odd, ritual gesture. Her lips moved as she recited something. Then, dry-eyed and composed, she turned to the flight deck hatch and undogged it.

"Rosario?" The cadet paused with the hatch open, about to push through, and gave him a questioning look.

"You pass."■

(Editor's Note: Jacinta Rosario also appears in "Prudence and Fortitude," April 1999, and the novel Lodestar *[Tor, March 2000].)*

Aristotle said that education was ornament in prosperity and a refuge in adversity.

— Diogenes Laertius

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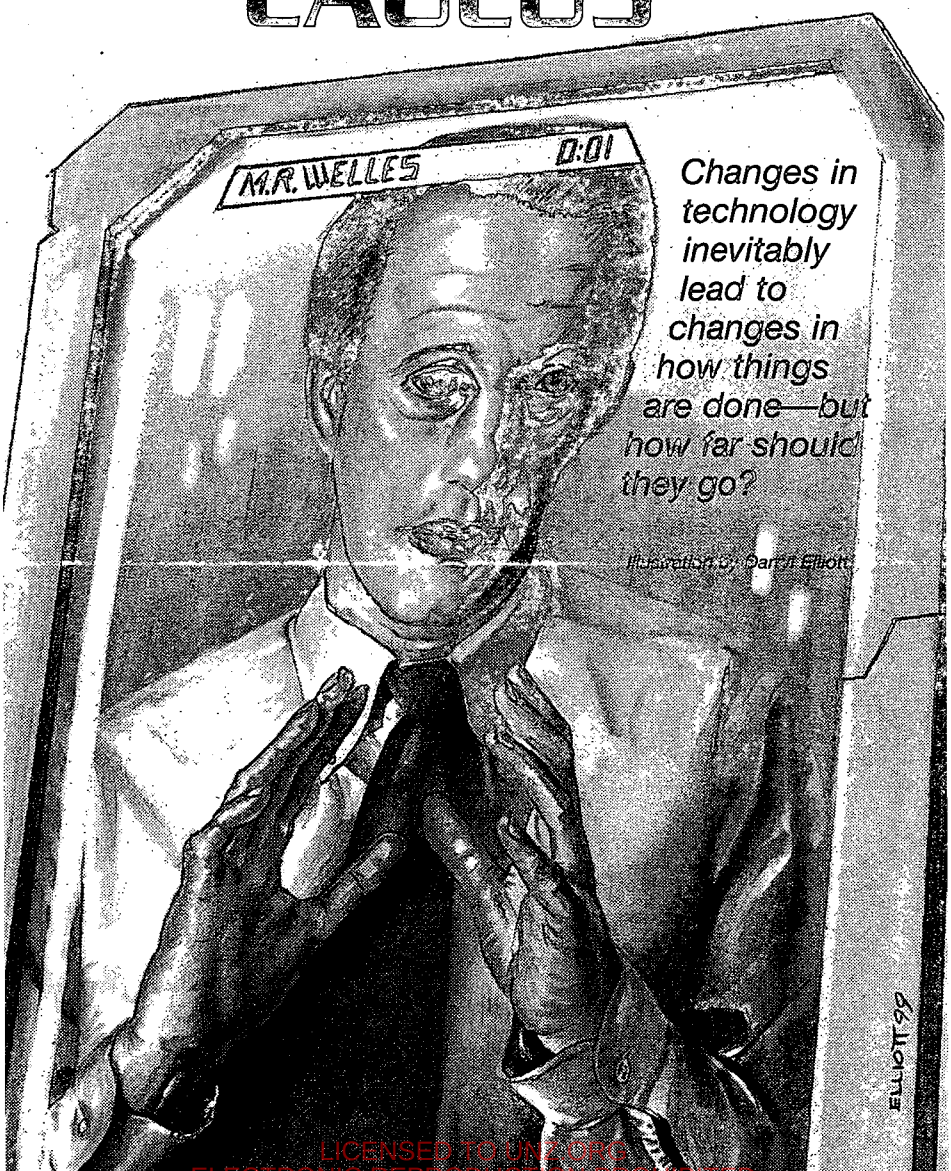
Shane Tourtellotte

THE VIRTUAL CONGRESSIONAL CAUCUS



Changes in technology inevitably lead to changes in how things are done—but how far should they go?

Illustration by Darrin Elliott

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"The chair recognizes Mr. Welles of Ohio."

Nobody walked to either podium on the House floor. Instead, three two-meter screens at the foot of the Speaker's dais flickered to life. Some of the scattered few representatives attending the One Minute speeches turned their backs, or began conversations with colleagues.

On screen stood a rugged man, thick-haired, bright-eyed, wearing a colorful tie with his subdued suit. A display case occupied the wall behind him, holding family pictures, diplomas, and the medals and folded flag he'd brought home from the Caribbean War. He adjusted something on his wristwatch, and took a controlled breath.

"Madame Speaker, four years ago, this body passed the Remote Representation Act, making it possible for me to address you from the home town I serve. It committed itself to an experiment, to learn whether Congress could perform its duties better by letting its members remain in the communities they represent, rather than becoming creatures of a distant city.

"Some members of this body have denied this experiment a fair run, grudging each dollar of appropriations, treating Stay-at-home Representatives as less than full participants. Having thus distorted the experiment, they now proclaim it a failure, and in a towering irony, propose that the states, and the country, be governed by Remote Democracy. They seek to plow under our modest trial by rewriting or ignoring the Constitution itself.

"I call upon my colleagues who support, and oppose, Remote Representation, to see that it has the honest test it deserves. Resist the urge to make change for the sake of petty partisan advantage. Let this experiment succeed or fail on its own merits, not on the dubious values of—"

Two representatives sitting close enough could see him finish with "politics as usual." The rest just heard the audio feed cut off abruptly. "The gentleman's time has expired," the Acting Speaker said, as the images of Welles disappeared.

After nearly four years, I should be used to Beltwayers' attitudes, Richard thought to himself. *Thank goodness I'm not.*

Richard typed out a request to the House recorder to add the last three words of his One Minute speech to the official record. There was a fair chance his email would be "lost," meaning treated as optional work, coming from a Homebody.

No, a Stay-at-home, Richard corrected himself. *Don't use your opponents' terms.*

That was on one side monitor in his office. A second showed his daily schedule, which he hadn't read yet. A third held constituent correspondence about his SIRA speech yesterday, also unread. The main screen was static.

Welles dug through his disk file and loaded a CD. It contained a one-time pad, specially made in Washington and delivered by courier, to provide transmission security unbreakable even by the latest quantum computers.

After a second of disk drive humming, the monitor cleared to show the Armed Services Committee room. Today was a closed session on New Soviet rearmament under the current strongman, General "Crazy Ivan" Hnatyshyn. The President might not think Hnatyshyn dangerous, but that didn't stop his party's majority in both houses of Congress.

Richard twiddled the camera joystick until he framed the testimony table perfectly. Then, with time before the session began, he scanned his schedule. He read one section three times, and called for Michelle. With his Congressional office occupying the third floor of his house, he didn't need to raise his voice.

"Yes, Mr. Welles?" Michelle appeared

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at the doorway, behind thick librarian glasses.

Richard hastily blanked the committee monitor, out of propriety. "No lunch dates?"

"Firefighters' Benevolent are talking business, and the schoolchildren are just visiting. Is there a problem?"

"Not unless you count cold cuts and indigestion."

Michelle tipped her head in feigned empathy: she always got a lunch hour. She returned to her desk without another word.

The committee had just convened when a quorum call came from the House floor. Richard loaded a fresh CD and voted himself "present," somewhat surprised. There would be a SIRA vote by the full House after all.

The Serial Individual Rights Act would recognize any clones descended from a person's DNA as continuations of that person's body, as long as those clones did not develop distinct self-identities. Nobody could dispute their owners' rights to do with them as they wanted—if they liked the promise of extended life enough to accept the premise.

The practical result was already plain in other countries: fetuses decapitated save for the lower brain, and matured in tanks to provide replacement organs. Other methods existed, embryonic stem-cell harvesting or nuclear transplants, but for reliability there was only one way to go.

Richard had spoken against it yesterday, and now looked over responses to that speech. Reaction to his SIRA stand had run negative before, but his speech reversed the trend. Many of the opposing messages he could dismiss: he recognized organized mailings easily.

The bill had struggled out of committee, but its chances before the full House were nil. Why was the majority setting itself up for failure, with dozens of their own casting negative votes? Richard didn't pretend to have the answer.

Soon came the call for a vote. Committee members excused themselves in small groups. Richard just hit a few keys, and stayed with the testimony on New Soviet air power. One more advantage of Remote Representation.

A quarter-hour later came the results: defeated 182-250. Wasted time—which Richard didn't have in abundance today.

Committee ran long, meaning Richard had to dash downstairs to meet the firefighters' group on the front porch. Jeffrey was there with a digital camera to take publicity stills, more for the visitors than the congressman. They finished quickly and got inside, escaping the scorching August heat.

He ushered his four guests into the parlor, what would have been a living room in a more average home. Posed political pictures covered one wall. They impressed visitors, but had long since blurred into background details for him.

Jeffrey handed Richard a sheaf of papers, and left. "You'll excuse some multitasking," Richard said to the firefighters. "Constituent feedback." They made approving noises at his commitment to the voters.

He scanned the pages. Reaction to his One Minute speech was negative, even with the usual artificially encouraged responses factored out. Passion was building over Remote Democracy, and he was on the wrong side.

The firefighters were lobbying for friendly legislation, things better suited for state or local law in Richard's estimation. When the sales pitch waned for a moment, he took the opportunity. "I'd like to discuss something unrelated for a moment, if I could. To gauge public thinking on an issue."

"Sure," they said, nearly in unison. Getting to play *vox populi* in person was a key reason why voters liked Remote Representation.

"All right. There's been talk building about Remote Democracy, and I—"

"Best thing that could happen," Beth

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Kessler, the youngest of them, said. "Put power directly in our hands, where it belongs."

"You'll get that moving, won't you?"

"Wait a minute, guys," said Joe Krystac, the white-fringed leader of the group. "Haven't you heard? He's coming out against it." He turned accusing eyes on Richard. "Maybe you'd like to explain *that*."

"Absolutely. I'm a believer in the system we have: separation of powers, checks and balances—"

"But you were all for changing it when it was something *you* liked," Krystac shot back.

He hadn't been in Congress when Remote Representation passed, but he didn't go down that blind alley. "That changed a method. What you're proposing would change the whole form of government. It would rewrite the Constitution."

"No, we wouldn't have to do that," Kennedy Blair said, waving his huge hands. "Just let the states go Remote Democracy themselves. An experiment, like yours, and when it succeeds, you'll have to follow along."

Richard controlled his hands. "You would still need an amendment. Article Four, Section Four of the Constitution states—"

"Oh, stop hiding behind the Constitution," Krystac said, leaving Richard speechless. "It's what we want, so get it done."

"That's why we elected you," Kessler added.

"No." Richard knew things were getting contentious, but he couldn't concede this premise. "You elected a representative, not a mouthpiece. My mind and my conscience are part of the political system. I can't vote for something I don't believe in. Does that mean I could lose your votes this November? Yes. That's part of the system, too."

Richard leaned forward, toward the fourth, silent member of the group. "You haven't said anything yet, Mike."

Mike Czyz's eyes darted furtively. "I haven't had anything to say."

Richard guessed he had a supporter, one not daring to throw himself against the tide. Democracy in action?

"Well, if you are serious about supporting Remote Democracy, I suggest you start studying the Constitution and the laws of the country. Understand what you propose to replace, and the responsibilities you propose to take upon yourselves."

"That's just another stall," Krystac said. "Why should we have to study like schoolkids before doing anything?"

Richard suppressed a smile. "Why should someone have to study before joining the fire department?"

"That—that—" Krystac sputtered on, turning redder.

"I'm sorry. I've raised a dispute I didn't mean to raise. Perhaps we should get back to your concerns now."

The firefighters agreed, most of them glad to be assuaged.

"'They're all alike,' That's the last thing I heard Krystac say as he left." Richard's slump deepened. "Whatever inroads I made with the others, I lost him. Why can't I keep quiet sometimes?"

Slender fingers began kneading his shoulders. "Because you're the White Knight, Richard. You can't see something wrong and not start riding to the rescue."

There was a quirk of humor on Erica's face, but her tone had carried all sincerity. "Which wouldn't be bad," Richard said, "if I could accomplish the rescue more often."

He craned toward his schedule, despite a protesting tug on his shoulders. The schoolchildren were due in minutes. Later came a lobbyist working on a subcontract from a large Washington PAC. Anyone could get on his schedule, but he could prefer some to others.

After all that, he had to chair a meeting of the Virtual Congressional Caucus. Richard had become chairman last year,

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after Pacienza learned that serving from home did not mean a lighter schedule. With other congressional caucuses, his chairmanship would gain him a measure of respect, but "Homebodies" got treated differently.

Richard grunted, partly from Erica hitting a sizable kink. "Why do they think they can have power without responsibility?"

"Because politicians say they can." Erica had been a party volunteer before they met and married, in the opening months of his congressional career. She knew political theory, and practice, at least as well as he did. "Who *wouldn't* want it?"

"Me. And why the rush? The first trial balloons floated just six months ago. Remote Representation was in the public eye two years before it reached a vote. Moore committed himself to it early in the '16 primaries."

"But he got elected on the war issue. Other policies didn't matter."

"They mattered to me, and I was fighting!" The hands left his shoulders. "Sorry, Erica. I should know by now when you're playing devil's advocate."

"That's right, you should. Oh, message."

An icon flashed over his picture of the House floor. That boded something important. Richard muted the audio, and opened the mailbox. All the tension returned to his shoulders when he saw the name David Paxton.

Paxton was the majority whip, terror of the House, darling of the media, and a Beltwayer, naturally. He had no official reason to speak to Welles, but unofficially, he enjoyed using his whip on more than his own party's members.

We should talk, the message read. *You'll be glad we did.*

"Oh, no," Richard groaned.

"Ignore him," Erica said.

"No, can't do that. Dogs can smell fear. Could you, uh—"

"Leave? You mean I can't stay to hold your white steed?"

"Not in your current condition."

"Hey, buster, five months along is not indisposed. I'll let you know when you have to start pampering me." She winked and blew him a kiss. "I'll go work on my book. See you later."

Richard watched her go, then sent a chat request before he could start procrastinating. Perhaps Paxton would be unavailable. Instead, he got an immediate video link.

David Paxton was younger and handsomer than anyone could expect to look after five terms in Congress. He was a fellow Ohioan, and local news outlets loved making lopsided comparisons between the two. Paxton smiled broadly, as though he were thinking about that right at that moment.

"Good to see you, Dick. Hope you haven't been avoiding me."

Richard hated that nickname, which was why Paxton used it. Paxton could be either "David" or "Dave," depending on which his audience would prefer.

"I was just reviewing this morning's vote," he replied, hoping that would sting. Paxton was a proponent of the clone bill. "What do you want today?"

"Want? I'm not taking anything, Dick, I'm giving it. Advice. I heard your One Minute this morning. Up to your usual standard." He didn't say what that standard was. "I'm willing to wager that it didn't get the best reception back home."

What could he know about that? Knowing Paxton's methods, perhaps a lot. "And your advice is not to make speeches any more?"

"My suggestion is that you pick your issues a little smarter. Remote Democracy is going to happen, Dick. Anyone who's not on the bandwagon will be under it."

Richard played nonchalant. "Well, if I'm going to lose my job, I may as well go down fighting for it. Come to think of it, if Congress gets replaced, you'll be out of work yourself. Maybe you should be picking your issues smarter."

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Paxton sneered. "You really must be this naïve. Nobody can act that well."

"Nonsense. You do, wherever there's a camera."

The sneer soured into a scowl. "If you haven't noticed, Welles, you're on the losing side of everything these days. Your precious president's back on the farm where he belongs, we've got both houses to boot, and Homebodies are political dead ducks."

"Right. Only twenty-three more dead ducks than last term."

"When you were boasting you'd double your number a year before we sent Moore back to his beloved sheep. Face it, Dick, you've shot your bolt. You're less than a quarter of the House, an eighth of the Senate. You try to play hardball with those numbers, and you will be running home crying for momma. And she'll be on *our* side."

Richard had a short, vivid image of putting a fist into those gleaming teeth. Knowing Paxton would enjoy knowing that helped him quell the urge.

"Sticks and stones," he said to Paxton, trying not to think that in this profession, names really could hurt him. "And honestly, do you think I would believe you're telling me all this for my own good?"

"I am. Leave this alone, and you don't make yourself a political target. Start leading a Children's Crusade, and your home district could get very hot, very fast."

Finally, the real message. Submit or die. Richard put on a smile. "Representative Welles thanks you for your message," he sing-songed, in the words of stereotypical Congressional replies to angry voter letters. "He values your input, and promises to give your opinions careful consideration."

Paxton snorted. "It was nice knowing you, Dick." He cut off.

No, he wants us lying low. He wouldn't start this if he weren't scared of us.

The meeting of the Virtual Congressional Caucus was chaotic from the start. All the members had received messages from Paxton in their official mailboxes, and a few had gotten video files. For a Beltwayer, Paxton was quite comfortable with the tools of the Information Age.

If he had meant to start a panic, and he probably had, he was close to succeeding. The Caucus had planned a mass defense of Remote Representation in One Minutes the next day, the last day before recess. Members were trying to squirm out now.

Paxton's giving us an opportunity to do his will without his having to work on it, Richard continued. *If he were confident of winning, he'd just steamroll us for laughs. He's showing weakness, not strength.*

He looked at the scrolling text on a side monitor. *Recognize Starke of Minnesota*, he wrote, and unlocked Starke's access to the conference room.

Easy for you to say, Mr. Welles. He's our whip, not yours. He can ruin my career, not yours.

Richard almost dashed back *That's what you think,* but didn't. The VCC had three members from the minority parties for each majority party member. He couldn't alienate that link to the majority, or the caucus would lose much of what strength and credibility it had.

He'll have to ruin twenty-three careers besides yours, Richard answered, *if we hang together. Your majority is seven votes, too slender for him to throw away backers. Say all you want about him, but he knows his math. Recognize Ang of Washington.*

But Paxton doesn't worry about bean-counting. His power goes beyond that now. He can wreck people during the day, and the news at night won't listen to one bad word about him.

Paxton did have a squeaky-clean image. Those few who had publicly decried his in-chambers strong-arming found their credibility immediately demolished. The rest had given up whistle-blowing.

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He wiped his brow. *Don't confuse an aura of invincibility with the genuine article. Nobody in politics is ever unstoppable.* He could think of a couple of negative exceptions, but now was not the time for doubts.

He's one. We're ninety-seven. We have a common goal: supporting and promoting Remote Representation. If we stand together, defend our ideals the way we're capable, we can make Paxton sorry he crossed us. And won't that be worth it?

He looked over, and grimaced. *Recognize Hays of Colorado.*

All of you may be stand-patters, but I'm not. Remote Democracy would finally break the stranglehold Washington has over this country. I for one am voting for it, and if you people supported real reform like you say you do, you would too.

Independent thinking, as always. Richard let other representatives answer him.

You don't even know what the final bill will say. How can you support it already?

Doesn't the fact that they won't commit to anything make you suspicious?

Richard let a few more replies through before taking charge again. *I won't force anyone to claim support for a position they don't believe in. We can still come together for the conviction we share: not having Remote Representation eroded away through negligence and contempt. From that stand, it will be easy enough to move forward, should the time come.*

Our One Minutes plan is unchanged. Anyone comfortable with speaking tomorrow, do it. Review your talking points, but try not to sound like a recording. Objections? He waited, but there were none, even from Hays.

The meeting shut down fast after that. Richard hurried downstairs after shutting down his office. Dinner would be cold, but maybe Erica would still be awake to eat with him.

***

The One Minute offensive went off admirably. Ang denounced lack of accommodation for time differences in western states. Carson decried the vacation schedule, made and maintained for Beltwayers to go home and claim to be in touch. Considine spoke about the meager staff and equipment allowances Stay-at-homes received, compared to their Beltwayer colleagues. Even Hays joined the chorus, with his call to make Remote Representation mandatory.

Welles expected an immediate reply from Paxton. Instead, he delayed appearing before the cameras until late afternoon, just in time to make the evening news.

"The demand for mandatory telecommuting of congresspersons is the latest example of hypocrisy from the Homebodies," Paxton said, wearing a synthetic smile. "Not only won't they allow voters the power they claim is theirs, they would deny their colleagues the choice of where to serve. I think we can ignore any future claims they make to intellectual honesty."

Four networks showed at least part of that statement. Welles waited for someone to question whether it might not be the people's choice where their representatives served. But no, Paxton wasn't the one who had to hold himself to high intellectual standards.

Hays was proud to have taken the brunt of Paxton's scorn. It made him feel relevant. Welles gently encouraged the sentiment, hoping it brought him further under the Caucus's tent.

The other members showed relief. Congress was in recess, and their stand appeared to have drawn no inordinate fire. The VCC had its nerve back.

Richard set to campaigning full-time. His opponent scarcely seemed to exist for several days. The disappearance was faintly ominous, but Richard didn't worry—until his campaign manager invited herself over for a conference.

"Congratulations, Richard." Jane

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Ovalenko smiled ironically as she shook her graying head. "You have become the number one target for defeat these midterm elections."

Richard nodded coolly, giving Erica's hand a squeeze. He had insisted on having her in the parlor—for political expertise, moral support, or simply holding his steed. "What details do you have?"

Ovalenko riffled through some papers. "My sources say Pendleton will be getting three million in support from his national party."

"Three million!" Erica exclaimed. "On a House race?"

"I wish my sources were less reliable, but they aren't. Of course, that doesn't count the national campaign—"

"National?" Richard kept calm, with difficulty.

"National ads in support of Remote Democracy, with you as the prime antagonist. They're also sending experts to run Pendleton's campaign, including a public-speaking coach. No more floundering like a vice-president for him."

Ovalenko handed her papers to Richard, who fanned them across the coffeetable to let Erica read along. She folded her hands on her short business skirt. "Now, is there something you should tell me?"

Richard looked up sharply. "Yes. They're not going to silence me. I'm sticking by my guns, so you can expect this to get worse."

"What a surprise. Maybe this will change your mind." She spread out more pages. "Currently, your lead over Pendleton is sixty to thirty-two, eight percent undecided. If nothing else changes—though you just said it will—your lead goes down to five points. That's twenty-three points gone in one wave. The next wave will drown you."

Richard nodded slowly. Campaign projection algorithms were Ovalenko's specialty. "That assumes, of course, that you stand still," she continued. "I have plenty of options—"

"We've had this discussion before, Jane."

"Yes, and high time we had it again. You can't win running a campaign that was naïve even in the twentieth century—and don't tell me about winning twice that way." Out came fresh pages. "You've lost the cachets of 'war hero' and 'outsider.' You've graduated to 'incumbent.' That shifts voter perceptions. They'll see a disconnect between your office and your affected style of campaigning."

Richard clenched his hands. "For the nine trillionth time, it's not an affectation."

"You say that—Lord help me, I'm starting to believe it—but Pendleton can paint it as phony posturing, especially now. Playing populist while standing so visibly against Remote Democracy will launch a lot of two-face ads."

"So losing my reputation for sincerity will win me voters?" For a moment, he believed she'd say yes—and he wondered whether the electorate thought the same way. "What do your projections say to that?"

She grimaced. "Granted, you lose points at the outset. That's why it's important to make the conceptual switch early, to have time to get it back with interest on gained effectiveness. Start with some D&C mailings, conduct test surveys to find the best push-poll questions, then—"

"No, no, no. I will not pretend to be different things to different people. D&C is out."

Differentiation and collation was the method of constructing different campaign literature for different voters, tailoring statements on various issues to the recipients' demographics. Richard had his own nickname for D&C: "lying."

Ovalenko tossed up her hands. "I have a reputation to uphold, Richard. Why should I help you if you won't help yourself, by letting me manage your emphasis on issues?"

"By demographic stereotyping? Erica's

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told me enough tales of how that goes wrong."

"Well," Ovalenko said, "she may be managing her emphasis herself, telling you what you want to hear. Are you going to denounce her?"

Erica scowled. "I won't tolerate lies about me!"

"It's not about lies. It's about politics."

"Not to Richard. That's what I liked about him from the beginning."

Richard spared a flash of sentiment for Erica, then got back on track. "Jane, I won't abandon my beliefs or principles to hold office. That's my price; I pay it. If you don't care to pay that price, you can leave my campaign staff, and I won't speak a word against you. What will it be?"

Ovalenko turned unsettled. "I didn't say anything about quitting. I just want to do the best I can for you."

"And you can, the same way you've done it twice before. Canvass the electorate, find where they think Pendleton's weak, and let me contrast my strength to that. Give me good numbers, give me good options, and give me good forums where I can talk straight."

He took one of the pages of Ovalenko's reports, turned it over, and began sketching out what he wanted accomplished. She listened, the coming onslaught set aside, if not forgotten.

Paper and electronic mailings went out Saturday morning, undifferentiated as always. Website updates went up the same way. Ovalenko called it "making the best of things."

Saturday evening, Richard received a revelation about strategic sacrifice.

The tape of Pendleton's campaign commercial showed Richard's floor speech against the Serial Individual Rights bill. It took Welles in his most strident gestures, with shadows of goosesteps and flutters of swastikas shaded in around him. A voice-over like the Final Trump excoriated him for thwarting the will of the people on SIRA, the same way he trampled their will on Remote Democracy.

"It's your country. It's your choice. So make Jeremy Pendleton your Congressman."

Richard clicked off the television, and found Erica standing behind him. "When did you two show up?" he said, glancing between her eyes and her stomach.

"Just now." Her face was grim, not holding the light of the room. "That was . . . pretty bad. The bright side is, the media might actually listen to a countercharge of demagoguery."

Richard pursed his lips sourly. "Wanna bet?"

"Not really."

"Hmf. Well, at least I know what I'll be talking about Monday."

The name "electronic town hall," introduced in the 1990s, had stuck to all such functions. There would be hundreds in his hometown VFW building hosting the event, but thousands telepresent over the Internet, with full audiovisual access, and the opportunity to ask their own questions, express their own opinions.

Richard's appearance on stage brought applause, and boos. A large contingent of Pendleton people had gathered in the back. Ovalenko had wanted the seating invitation only, but he had overridden her. He preferred converting critics to muzzling them.

Chants of "We're for democracy, not your hypocrisy" nearly drowned out his supporters. Placards unfolded on cue. Richard noted two misspellings of "fascist" right away.

"Good evening, ladies and gentlemen, here and at home." His opponents almost drowned out his greeting. He stood calmly, eyes directed at their group, and waited. Nobody could mistake what he was waiting for, and within a couple of minutes, fatigued vocal cords gave it to him.

"As always, this forum will be open to

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any statements and questions you have. My opening remarks, however, will touch solely on one topic: the issue of Remote Democracy." Catcalls surged, and subsided.

Richard had toiled at this speech all weekend, marshalling every nagging qualm he had, organizing them to best persuasive effect, and reading five drafts to Erica before settling on one. With any luck, he could silence his antagonists without having to shout them down.

"The framing of the American Constitution took months of contention in stifling Philadelphia summer heat. The reason it took so long was that the framers had so many safeguards to put in place, to insure the new government would not turn oppressive."

"Like you!" someone shouted in back. A supportive cheer ran afoul of hushes and other admonishments from the audience.

"Their safeguards were threefold. They instituted checks and balances to restrain branches of government against each other. They codified the Bill of Rights to harmonize government power with individual liberties. And they instituted a representative republic, to shield the law and Constitution from being overturned for light and transient causes.

"Making a law under our system takes time and work. Altering the Constitution is harder still. Why? Because slowing the process gives calm deliberation more weight than transitory ardor. The framers understood how people can be carried away by their passions—as many are today with Remote Democracy."

He ignored hisses. "From its proponents, we have witnessed inflammation of emotions, stampeding of opinion, calls for action regardless of its content. In short, we are seeing the things that, in a direct democracy, would bring chaos and ruin.

"A government so vulnerable to manipulation would be liberty's nemesis, not its guarantor. Unscrupulous majorities could pass any law they pleased, unfettered by today's constraints, by the levels each act must go through to become law. James Madison, in his famous Federalist Paper Number Ten, said that preventing the tyranny of a majority faction was the great desideratum of this government.

"What guarantees will the majority give to the minority to protect their rights in a direct democracy? What compact will unaccountable manipulators of opinion make with anybody?"

He paused, reading the faces in the audience, seeing the gears turning in some minds.

"Many people think Remote Democracy is the answer, when they haven't asked the question 'What will Remote Democracy be?' Until we have a complete answer to that, all we have is a slogan ... and liberty and justice cannot survive on slogans alone."

The audience took several seconds to realize he had finished. Half the audience joined the ovation, but they made it sound double their strength. Those in the back held their peace.

"Thank you. Now we'll begin the open forum." Dozens of hands went up. He pointed toward someone in the middle row. Him, then a cyber-attendee, and then he'd contend with one of the dissenters.

The sharp-faced man stood. "My name is Louis Williams. You tell us Remote Democracy will let people distort facts and manipulate emotions. The same things happen right now. What's the difference?"

Despite the strident tone, Richard liked the question. "The difference is the lessened power that manipulation has now to affect the making of law. You may have noticed some of the distortions propagated about me. I can refuse to—"

"I'm *talking* about you! *You're* the liar!" A swell of acclamation rose from the back, and Richard realized he shouldn't have expected the opposition to clump completely together.

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"You deny us self-determination, and tell us it's for our own good, when it's really for yours! So tell us, how does your system protect us from your lying?"

Calm, Richard told himself. *Let his own shrillness discredit him.* "A republic provides buffers from artificially created passions, more opportunities for reason—"

"See? You're calling the will of the people artificial. That's you guys all over!" The agitation of Williams's allies began to gain a few new adherents. "You still won't answer my question. What stops you from being manipulated—no, from doing the manipulating?"

"The fact that I'm not bound to execute the will of whatever majority exists at the moment, the dictates of my conscience, and—"

"So nothing's stopping you!" Williams gleefully concluded, to cheers and laughter.

Richard's hands lay on the lectern, veins starting to protrude. "I think anyone else would agree that plenty has kept me from submitting to this manufactured clamor—and I see my opponents are good at such manufacturing. Our republican form of government—"

"Is your personal toy, and now that we won't let you play with—"

"—gives us a chance for reason to prevail that otherwise doesn't exist!"

"Hey! I don't interrupt you!"

The meeting room erupted into hoots, catcalls, chants and shouts. Richard could only watch, helpless to restore order. Apparently he had said too much already.

Within two days, Pendleton's ads featuring footage from the disastrous town meeting premiered. They prominently showed a security guard dragging away a protester, to ominous music and voice-over. The two innocent spectators the protester had elbowed to the ground, they somehow missed.

Richard put the uncut video on his campaign website, but it didn't expunge the slander. His opponents had better media connections, and that meant publicity control. On television, in print, and from Pendleton22.org to dozens of grass-roots websites, Dick Welles was savaged. Never "Richard," always "Dick."

With great fanfare, the Pendleton campaign announced that they had made up half their deficit in a week. It was an email poll, thus querying those most attracted to Remote Democracy, with questions worded to get their man the best possible numbers. The media could raise themselves in indignity over such push-polls, when the mood struck. It didn't for Pendleton.

Ovalenko's polls, properly balanced at Richard's behest and under her protest, showed marginally better numbers. She spoke vaguely about how bad a projection run to Election Day would look. Richard did not take the blatant hint.

He did accept her advice in taking Friday afternoon off from campaigning. No use being in public at a moment that was obviously Pendleton's. Of course, he couldn't get away from Pendleton by staying at home: that was the point.

Sounds got into the bedroom from the rally, at the park bandstand a scant three blocks from Richard's house. Pendleton was holding this big event in his opponent's home town. Worse, David Paxton had come along to lend his support. Far worse still, so had the president.

Not the incumbent. That would have been less galling.

Richard sat in a chair, skimming through his email files on a laptop. Organized write-in campaigns had swamped his staff, and notes to his personal address he legally had to handle himself. Erica sat on the bed, going over book notes. They shared a room, but it wasn't quite togetherness.

A massive cheer went up, thousands of voices in unison. That had to be him. The sound soon transmuted into something

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so familiar it eluded Richard for a second. He finally pinned it down: "Happy Birthday." Wonderful piece of timing, that.

A raspy, tremulous voice carried to him. Fingernails clenched over the keyboard. His eyes bored into the floor, out of a face of stone.

A slam roused him. Erica had shut the window, and was moving to turn on the air conditioner. "Honey, no," he protested. "It's cool out, and we're trying to economize."

"You aren't economizing," she said, cranking the machine to a roar, obliterating the outside sounds. "You're torturing yourself. Don't you think I know how you feel about him, Richard?"

Richard had come of age intellectually during that president's administration, horrified at what went on, disgusted at the indifference, the approbation of it all. His parents had endured similar convulsions in their time, had their sensibilities molded by a previous era. When it happened anew, with one of *theirs* the miscreant . . . well, Father was dead now, and Mother might have been leading the singing outside.

"It was a long time ago, Erica. I have my own little disasters to contend with today."

"Like the town meeting Monday?" A tight smile fixed on her face. "Well, that's what you get for obstructing the will of the people."

His eyes widened. "No," he whispered, "anybody but you."

With an innocent look, she began reciting. "Whenever any form of government becomes destructive of these ends, it is the right of the people to alter or abolish it, and institute new government. . . ."

Richard's eyes began glazing in shock. "Do you honestly think our system is that broken? I don't."

"Maybe it's not for you to say—"

"Who else, then? I'm supposed to be a leader."

"Funny. Any other time, you'd say you're supposed to be a representative."

Richard stood. "If that's your opinion of me, I won't trouble you with my presence." He stalked toward the door, but a tug on his shoulder pulled him around.

"Richard! Devil's advocate, remember? You've been so morose the last three days, I wanted to see if you had any fire left in you. Guess I found out."

His relief quickly dissipated. "You weren't making those things up, though."

"No, because it's time you faced something, and better I say it than anybody else." She guided him to the bed, and sat beside him. "You talk about respect for the system, safeguards against bad law, but what it boils down to is that you don't trust the people to make the right decisions."

Richard didn't even budge his jaw. Erica smiled sadly.

"It's not surprising, really. Growing up under him—" A cheer outside briefly outvoiced the air conditioner. "—your parents fighting over his scandals, splitting up. That, and how the Caribbean War started, and what happened to President Moore, have thoroughly trained you."

Richard met her eyes. "If the public can't be trusted to act with some minimal wisdom, any institution based on their desires, *any* institution, is doomed. Are you saying we're doomed?"

"It's how you've acted the last few days. You're scared to death they'll ruin your country, and some of them are starting to figure that out. They aren't likely to appreciate your concern, no matter how justified."

He slumped. "So what do I do? I can't deny what I believe."

"You did—to yourself." Her arm went around him. "I don't have your answer, but don't let that stop you from looking for it."

Richard let himself fall into Erica's embrace, saying nothing, his thoughts too tumultuous for words.

* * *

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"Wouldn't it be easier to buy a security program, sir?

Richard looked up. "Jeffrey, I spent twelve years in CS&I in the Army. I can make my own, thanks."

Jeffrey let him do that. Hackers had been trying to sabotage the campaign website for weeks, and they were getting too close for Richard's comfort. He took time to strengthen its defenses, considering it a form of relaxation. Anything off the campaign trail was relaxation.

He had shifted his focus to safer grounds, his stands on defense, Lunar colonization, trade, caffeine control. Ovalenko was horrified, but he couldn't campaign on Remote Democracy with his current uncertainties. His reasons didn't sway her, or affect the people.

Protesters now camped on his lawn during daylight hours, chanting slogans and harassing visitors. The Supreme Court had sanctioned such demonstrations on free speech and petition of Congress grounds the previous year. Richard might successfully have challenged the intensity of the protests, but that was political suicide, just what they wanted.

Besides, he perversely welcomed the reminder. Alexander Hamilton had written that a candidate ought to allow the people "their proper degree of influence upon his conduct." Perhaps this was his penance, for thinking he was smarter than two hundred million American voters.

Richard ran the security program through its paces, smiling grimly. It felt good to have confidence in his ability to protect *something*.

We held a sub-caucus during the recess, Representative Ang wrote to the conference room. It was their Sunday night meeting, preparatory to returning to work. *We've all seen what's happened to your campaign. Our opponents are starting to sing the same tune. This may be a fight we can't win.*

Richard felt some of his old defiance, tempered with new uncertainties. *Mr. Ang, since when have you felt unable to come to me directly with your concerns?*

Since you have the moderatorship. We couldn't be sure of a fair hearing. Others echoed the sentiment on the side monitor.

I see, Richard typed slowly. *I construe this action as a vote of no confidence, and will resign my chairmanship of the Virtual Congressional Caucus, effective in three days time. We will meet again on Wednesday to vote for a new chair.*

Until that vote, I request—I no longer have the mandate to do more—that you refrain from altering your public stance on Remote Democracy. Whatever strength this caucus has lies in its unity. Please, do nothing to dissever that unity, or you will surely wish you had it back.

Messages crawled across the second screen, but there was no more to say that night. *Meeting adjourned,* he wrote, and shut down.

How fast things had changed, from rallying almost a hundred Representatives to yielding at a touch, in under a month. How could he lead, though, when he didn't know which way to lead them?

The morning Congress reconvened, Ovalenko's polls showed forty-eight percent of the people thought Richard Welles was out of touch. Forty-five percent believed a Congressman should be barred from having an unlisted personal phone. Richard's lead tottered at seven points. The new projection to November showed a tie.

Richard started work early that day, surveying the amendments introduced on the House floor that session. Hundreds of amendments came up every year. Half died of neglect; the other half went to committee, where most died of scrutiny. One or two might reach a floor

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vote, and be mown down. The last amendment to get through Congress had been in 1972—and the states didn't ratify it.

Richard wasn't thinking about ratification. He wanted to understand Remote Democracy's advocates and their ideas, expressed in the more than one hundred amendments they had produced.

Most of them were feeble, with enervated mimicry of old checks and balances, and fuzzy delineation of powers that would tie up courts for years. Some of the writers were trying, barely, but nothing satisfied Richard. Perhaps it was his lingering preconceptions, though he believed that less and less.

One of the last amendments was before the Government Operations Committee on Tuesday. Richard arranged a feed from Emil Pacienza's committee seat, so he could watch the debate, then set to reading the amendment.

It effectively nullified half the Constitution, as most of its cousins did, and in its place left . . . autocracy. Overseers for the same old districts, empowered to enforce "equitable procedures," but with no practical limits on their powers. They would be elected directly after a long transition, but appointed by the President at the start. With the six-year time limit for ratification written into the proposal, there was no doubt which President they intended to make the appointments.

There were myriad details, but they changed nothing. Petty satraps, unhindered in manipulating the voting process, including or excluding at will. If Richard had any comfort, it was that this amendment had absolutely no hope of passing.

So why was the chairman bending over backwards on its behalf?

Richard kept watch for hours, always having the committee room on one screen while he attended to more immediate business. He sent a summary to the Caucus at day's end, with a suggestion that they follow the next day's doings themselves.

He attended all day Wednesday, grudging for once the time he set aside to meet constituents. The committee threatened to stretch into evening, but the chairman pushed for a vote. Richard wondered why: he didn't have the votes yet.

Wrong again.

The committee split cleanly down party lines, but passed the amendment. Next stop was the House floor.

After an ominously quiet dinner with Erica, he watched the evening news hail a shining victory for democracy. Not "Remote" any longer, just democracy. The MSNBC-Journal flash poll put public support for the amendment at 62 percent. CBS-Times-AOL said 65 percent. Percentages of people who knew what the amendment said, he guessed, were far lower.

He logged back on a quarter hour early for the Caucus meeting. Half the caucus members were already on-line, with more joining each minute. Before he could change settings to 'moderated,' Hays from Colorado wrote.

Let's dispense with formalities. We've got a quorum. I open this meeting by nominating Richard Welles as chairman of the Virtual Congressional Caucus. Seconds?

Richard's screen scrolled too fast to read the names of everyone who seconded. The next chance he got to interject was in the stillness after a call for 'nay' votes. He wisely refrained.

Motion carries, Hays wrote. *Now, Chairman Welles, got anything to say to us?*

Nothing you couldn't guess. We are going to defeat this amendment, and I am personally going to get to the bottom of how it got this far.

Do you have a theory? Ang wrote.

Three guesses, Wallace. Three guesses.

Jeffrey and Michelle came in early to help with the mailing next morning. Members of Congress still retained free franking privileges for informing constituents of the work of Congress.

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Welles sent full texts of the amendment, with his commentary, to every constituent for whom he had an address, paper or electronic.

He got into his office barely in time for his One Minute speech. His topic was obvious, as was that of every VCC member who followed him. He didn't stay to listen, as he had someone to call.

Richard kept his face neutral as David Paxton's popped onto the screen. "Hello, Dick. To what do I owe the pleasure?"

"Curiosity. You backed this amendment. The way your committee members fell into line proves that. Why this one?"

Paxton's smile was already turning insufferable. "It's a good amendment, Dick."

"Good? It's a recipe for arbitrary rule by a self-perpetuating cadre." His control was slipping, and he let it. "It's absolute power in little pieces."

"There's nothing wrong with power, Dick. It's how we get things done."

Richard's arms went limp. "You can't be serious. Putting an end to democracy, under the banner of democracy itself?"

"Are you always this hysterical? No, stupid question, of course you are. This won't diminish the will of the people at all." His teeth showed to the points of his canines. "We'll just shape that will to suit our ends. We'll do what the public wants, because we'll make the public want what we do. Elegant, isn't it?"

"Impossible." It emerged as a hoarse whisper. "People will know the truth."

"Truth is statistical, Dick. It's what you make people believe, about Remote Democracy, or Moore, or you."

Richard tensed at the veiled threat: President Moore, headed to a narrow reelection victory until a depraved rumor emerged four days before the vote. Long enough to taint his name; not long enough for truth to uproot the falsehood. People still believed Moore guilty because the voters had found him guilty, at the ballot box.

"You won't frighten me with talk about Moore," Richard said tightly. "This amendment won't pass. Too many of us care about justice to let it."

Paxton whooped. "You are *such* a cliché. The winners make law, Dick, and the losers cry for justice. If you think you can win, go straight ahead and try."

"Good to see the fire back, Richard. I wish you'd get fired up about something else."

"Jane!" Richard followed her across the floor of his campaign headquarters. "Two weeks ago you said you wished I'd leave the 'irrelevant issues' alone."

"Yes, but I was hoping you'd come to your senses on RemDem—" The abbreviation was becoming popular. "—not go farther off the deep end."

"You only see polls—and didn't you say my amendment mailing gave me a boost?"

"One point. People open to your arguments are already with you." She sat at a terminal. "And of course I only see polls. That's why you hired me. Being Congressman is your job. The trouble is getting our jobs not to work against each other."

Richard settled in behind her, reading her latest numbers. "Three points ahead. Statistical dead heat."

"That's what the media will say," Jane confirmed. "I still say let me skew our poll questions. I'm very precise. We can feed better numbers to the news, and not lose accuracy on the real situation."

"Jane, I won't do that."

She nodded, acquiescing. "Is there anything I can do?"

"Yes. Let loose your volunteers on the chats." Internet political forums were rife with planted operatives driving discussions, instigating flame wars. Welles had been a special target.

"Really?"

"Yes, but no scripts, and no paying for opinions. Understood?"

"Suits me." She started banging out a

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message. "Paxton must really have gotten under your skin."

"He's dangerous. Much more dangerous than I'd realized before."

"Yep, with that face and that name, 1600 Pennsylvania's the limit."

One of Ovalenko's pet algorithms calculated the positive or negative effect one's name had on one's election chances. Her favorite discovery was that having a surname ending in "on" made you a two-to-one favorite to win a presidential election. A third of all presidential elections went to "on" names, and several more to sound-alikes "an," "en," and "oln."

"That's not the danger I meant," Richard intoned.

"Oh, you're just throwing sour grapes." She had formerly bemoaned his first name, with its unfortunate diminutive, and the fact that, out of ten presidents with one-syllable surnames, only Grant won re-election. He had bristled at her fortune-telling, and at her assumption that he aimed that high.

"Trust me," she continued, "he's looking ahead. He wouldn't be running for the Senate in two years if he weren't."

"He's challenging DeWitt? When did you hear this?"

"In bits and pieces," she said, typing without pause. "Word is, DeWitt's being nudged aside, to give Paxton a clear primary run. After that, the two following presidential cycles fall in non-re-election years for him. The conclusion draws itself."

He swallowed hard. "That's appalling . . . but I'm busy enough worrying about today."

"That you are." She banged the enter key. "At least he has you re-energized."

"No. Not him; not completely."

How could he explain? Awful as his confrontation with Paxton had been, it had given his faith in the American people a last desperate purchase.

The hecklers at campaign stops; the sit-in now conducted around the clock at his house; the mass downloads that threatened betimes to crash his campaign site. It wasn't that they were false, but with the glare of Paxton and Pendleton behind them, the shadow they cast over him was out of all proportion to their true size.

They were the loyal core. The others followed because believing what they were told was easier than uncovering the facts for themselves. Given disinterested information—given the truth—they would make the right decisions. They would prove themselves worthy to hold the reins of government. Otherwise, the first maxim he learned about computers applied: "Garbage in, garbage out."

Did he believe that hypothesis? He had to. He needed *some* faith to carry on.

Welles maintained daily updates, relating copious details of the amendment debate in the House. He quoted adversaries' speeches whole from the Congressional Record, with his own biting commentaries added. He turned no blind eye to the unsavory cajoling and coercing, to promises made in shadow, and broken in daylight.

The one thing he concealed was his confrontation with Paxton. Sullying that pristine public image would be poison; he'd be tarred a liar and demagogue. He half-wished he had taped their talk, but that was illegal, and against him, the House would surely enforce that law.

By day, he exhorted the VCC, and his party members, to follow his lead. Many of the latter shied away: they could sense risky associations, and Welles carried an aura of danger. He granted them the courtesy of leaving them out of the website updates that consumed his nights.

He feared Erica would suffer from neglect and harassment, but by the third night she was there beside him, proofing what he wrote. Ironically, her support worsened his anxieties. Paxton or his friends could manufacture a scandal at any time. Probably sexual—always fair

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game when *they* alleged it—though he didn't put alleging war crimes past them. Erica wouldn't credit such lies, but the inevitable prejudgments would be an enormous burden for her.

She would surely chide his overprotectiveness of a political veteran: white knight, indeed. It didn't matter. He wouldn't relent in any case, even for her.

The final vote came on a Tuesday, thirteen days after the amendment left committee. 171 for, 264 against: far short of the 290 needed to pass, but better than most news outlets had predicted. Two dozen from the minority had voted 'yea' for public consumption, not for real support of the amendment, and in full confidence that they wouldn't accidentally pass it.

The Virtual Congressional Caucus had shown more integrity: 0 yeas, 97 nays.

Richard sent grateful email notes to them all, waxing orotund about the faith in the ideals of government that united them. He urged continued vigilance, though even he felt a relieved letdown. His campaign trail would be all the steeper now, but at least he could relax on the Congressional front.

His relaxation lasted one day.

"Michelle, could you call my wife up here?" He scarcely heard the acknowledgment, as he reread the new measure before Government Operations.

This one was a mere bill, not an amendment, but still it meant a change to the Constitution. It redefined the Article Four guarantee of a republican government for each state to include direct democracy, thus allowing the states to alter their governments as they saw fit.

It also phased out all federal grants to states that did not adopt Remote Democracy. It was the method Washington always used to enforce its will, writ large this time. States that uniformly remade their laws on pain of losing a tithe of their highway funds would surely toe the line to avoid stark beggary.

The "overseers" were back, too. House members would now insure fair dealings in their states' democracies, as well as represent those states. The limits on their powers were only whatever their respective state caucuses agreed they were.

Erica came in, and he silently scrolled the text of the bill for her. She sagged noticeably. "I must be out of practice. I should have seen this coming."

"What do you mean?"

"The amendment was a classic feint." She pulled over a neglected chair, and eased herself into it. "It spurred you to spend your strength on something they didn't expect to pass. Now, with your passions dulled, political capital depleted, and defenses weakened, they launch the main attack."

"It doesn't matter. Overturning a constitutional guarantee requires an amendment. This bill is unconstitutional. Everyone will see that."

She shook her head. "We're in the age of people power, Richard . . . and people see what they want to see."

"—arguably they have always had the power to institute direct democracies. Initiative and referendum already exist in many states, never successfully challenged as violating the guarantee of republican government. It's too late for opponents to start splitting hairs—"

"—justified their existence by broadening the definition of 'assembly of Congress,' but now they object to someone else using their methods. The Homebody hypocrites have been hoist by—"

"—this Supreme Court has always seen beyond narrow interpretations of the Constitution, Sam. I'd be surprised if even four Justices voted against—"

"—masterful compromise by Paxton, on the heels of exceeding expectations on the amendment vote. The obstructionists can now meet him halfway, or cling to their extremism and open themselves to voter backlash in November. With Dick Welles now losing his race, the rest can't miss the writing—"

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Richard shut off the television angrily. One point ahead would have been a "virtual dead heat," but since he was one behind, he was losing. Two cheers for freedom of doublethink.

He rubbed his forehead, then watched four hairs twirl down to his dark pants. He imagined Ovalenko taking a caliper to his hairline, projecting the resultant loss of support. One vote per hair, maybe?

It seemed to be going that fast in the Caucus. So far he had thirteen members ready to break ranks, some because they supported the bill, some to distance themselves from him. So much for idealism and unity.

Still he fought back. Ovalenko would push the compulsion angle in their next ads. The spectacle of Washington forcing the states to adopt Remote Democracy might sway some minds. Sadly, he suspected a majority of voters appreciated the coercion, as long as it got them what they wanted.

Strange that he had seen Paxton as a bright spot when this latest fight began. With the amendment a ruse, Paxton's repulsive words in its defense smelled of an act, a provocation to make Richard exhaust himself in that one fight. His philosophy wasn't really one of power and privilege, infinitely feeding one another.

Try as he might, he couldn't convince himself of that.

When Richard decided to "go retail," Ovalenko raised no objections. With few visitors crossing his home picket line any more, it was one way to combat Pendleton's escalated charges of indifference, detachment, disconnectedness. More likely, she had run out of ideas.

To Richard, it was more an experiment than a campaign strategy. Going out on weekday evenings to canvass neighborhoods door-to-door wouldn't gather many votes. It would put him out of the organized protesters' reach, which was part of his plan: to observe events in isolation.

Renewed urgency came from the two riders attached to the bill in committee: The Freedom of Information Access Proviso, and the National Citizens Database Measure. They confirmed his worst suspicions, but also gave him arguing points.

"How can you oppose giving computers to the poor?" Brenda Sewell said. She sat side-by-side with her husband in their living room, facing Richard. Their five-year-old peered in from the staircase, catching glimpses of the stranger he somehow knew was important.

"It is better than making them go to public computers to vote," Ken Sewell added. "And it's not like you objected to *your* free computers."

Which would disappear when—no, *if* he lost. Richard resisted the bait, concentrating on the twenty percent of Americans without Internet access.

"Computers specially programmed to monitor their use. Right here, second page," he said, pointing to the clauses on the printouts of the riders he had given them. "Do you trust the government enough to let them monitor *your* computers?"

"But—but it's to prevent fraud," Brenda said. "And it won't be us."

"For now, but soon someone will say it's unfair to monitor some but not others. Do you think they'll stop monitoring theirs, or start monitoring yours?"

Brenda looked distressed. Ken's brow crinkled.

"Besides, the Database will have plenty of information about you anyway, information you'd never permit a business to accumulate, if you could stop it. That *will* be you, Mrs. Sewell."

"But that's to protect our rights."

Ken turned. "But they never needed that much when we registered at the courthouse. Why so much now?"

She stammered. "This is national, more important."

"So, in the name of expanding your

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rights, you'll trade them more knowledge about you, more power."

Her eyes hardened on him. "You're so mean, confusing the issues like this."

"No," Richard said softly, "the authors of this bill are counting on confusion. I'm trying to untangle their knots." He handed over a new sheet. "The text of the bill is on-line, just as I've printed it out. Go to that address. Look it over for yourself. Study it. Don't take my word for it; don't take *theirs*, either. Know it backwards and forwards, then decide."

Ken took the paper, his other arm around Brenda. "You're pretty confident we'll see it your way."

"In a fair fight?" Richard grinned. "Absolutely. Best odds I've had in months."

New voices appeared in discussion groups. They wrote calmly and cogently, unusual itself on any forum, much less a political one. When the attacks came down upon them, with surprising fury, it only convinced them more that they were right.

Stray comments also let Richard know they were talking with neighbors. Richard had visited only a few houses on each block, to cover more ground. The ideas he had seeded were growing to fill the empty spaces. They even seemed to affect his poll numbers.

"Down by four now," Ovalenko reported. "Hasn't fallen as far as I'd thought. Maybe you should stay out of sight more often."

She thought his cause lost. As far as reelection was his cause, she was right. The national committee had quietly cut off his funding, giving no public reason but privately castigating him for putting his quixotic crusade above the party.

His real cause, defeat of the Remote Democracy Act, twisted on an unraveling thread. Defections from the Virtual Congressional Caucus rose to two dozen as the Act passed committee. His persuasiveness outside the caucus was zero, or negative.

"Yes, it's bad law," he heard time and again from other representatives, "but they'll pass worse next term if we slit our own throats voting it down. Time to cut our losses. Don't call me again. I can't risk being . . . associated."

Assigning VCC surrogates to make his arguments went somewhat better, but the votes were firming up. After three days of raucous debate, from which he remained publicly aloof, he counted 210 probable votes for, 210 against, with fifteen floating undecided.

If he failed, there wouldn't be another chance. Remote Democracy would move on to an obliging Senate, an eager President, a sympathetic Supreme Court, and then . . . then he would have to hope he had been paranoid.

The final day of debate stretched into evening, stringing out so people on the West Coast could finish work in time to see the vote live. One network had broomed its schedule to carry the vote, almost unheard of in the age of near-universal cable and Internet. America was watching.

A quorum call came, preparatory to the main vote. Richard popped in his voting encryption CD, then went to get water. Returning with his glass, he saw, not the familiar voting display, but an error box.

"Incorrect decryption protocol. Please insert proper disk."

He checked the disk, double-checked its delivery materials for the date, and tried again. The same box appeared. He tried two other disks he had not yet discarded. They failed as "outdated" rather than "incorrect."

Richard put back his regular encryption disk, the one he and the other Stay-at-homes used for mundane security, and tried to inform the Remote Liaison of his malfunction. "Unauthorized user. Submit accepted decryption protocol to obtain access."

Richard's shock lasted barely a second. "Michelle!" he shouted, as he slapped his chat security floppy into its

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slot. This was commercial issue, not government. If it failed, his problem was hardware. If not. . . .

"Michelle went home," said Jeffrey from the doorway.

"Never mind. Call the Congressional switchboard, by telephone. Ask for the Remote Liaison. My encryption software's glitched."

"Telephone? Okay."

As Jeffrey disappeared, Richard hailed Wallace Ang. *Wallace, is your voting encryption giving you problems?*

Yes. I'm just notifying the Liaison Office, and—

The sentence hung uncompleted for a moment.

Richard, I'm locked out of CongressNet. You're all I've got.

"Oh no." *I'm notifying the whole VCC. Hold on.*

He dashed off a message, telling them to call the Liaison Office, and not to vote. Doing that would freeze them out. But it was five minutes into the quorum call, and Stay-at-homes rarely had reason to delay. A few even had bootleg programs to mark them "present" when they weren't, to keep their attendance record up.

"Please, please," he mouthed into clasped hands, "let someone have gone to the bathroom."

Caucus members began signing on in the dozens, filling the side screen with protests. Richard moderated them out, and waited until he had them all. That itself was a bad sign.

Did anyone not attempt to vote yet? Answer only if you didn't. Nothing.

Did anyone vote successfully? Affirmative only. Nothing.

Is anyone not getting error messages when they try to access CongressNet?

Many said they had one-way access, Washington to home. Nobody could send a bit of data out. *How will we tell them what's wrong?* several wrote. *Do they even know?*

I hope so, but my office is reaching them by telephone now. Wait.

Jeffrey was back, shaking his head. "Can't get through, sir."

"The phone's dead, too?" He looked at the House floor screen, to make sure the Capitol was still there.

"No, the switchboard's overloaded. Nothing but recordings. Guess that call-in drive worked better than they expected."

"Call-in?" Richard's voice was rising. "Who? Why?"

"To show public support for the bill. The usual people were pushing it: Ugarte, Paxton, Pfister—"

Blank disks leaped from the impact of Richard's fist on the desk. "Try email, unless they—no, even if they did clog that. Keep trying everything, Jeff."

He lurched back to his keyboard. *Non-computer channels to Congress are jammed. Worse, spammed. I think this was deliberate.*

Reaction was swift and intense. Richard let Starke's comment through. *To keep us out of the vote? Ridiculous! They wouldn't have sabotaged my encryption. They knew I was voting their way.*

Selective access failure would never look accidental. All or nothing, and with a four dozen vote swing, they picked all.

He turned on a television in the corner, pre-tuned to C-SPAN. Six minutes remained in the quorum call, and already there were enough present to proceed with a vote.

Call offices in Congress, he wrote. *Call reporters. Get someone wise to the shutout. But if you can't do it and stay with the Caucus, don't. I need you here when we find a solution.*

He ran to the outer office, and saw Jeff shake his head. "Call local news affiliates," he told him. "Call national ones. Tell them what's happening. I'll do the same here."

Back in the nerve center, he sent hasty email to the five news sites in his address book. He still needed a Plan B, but what could he do, short of hacking into the most secure non-military com-

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puter network on Earth? He was good at Computer Security and Infiltration in the Army, but *that* good?

Hacking CongressNet from scratch would take many hours at best, which he didn't have. He needed a closer starting point. The corrupted encryption disks, his and his colleagues', might be it.

The one-time pads on those disks were random, with a "protocol" required for access to them. Protocols were the products of immense prime numbers. It was a decades-old encryption trick, still used even though new quantum computers were adept at factoring the primes from the product.

One prime was static, different for each Representative or Senator. The other changed daily or more often, necessitating the constant flood of new disks. The products they made confirmed one's identity and right to access CongressNet.

Change either prime, and the product would fail. A single bit would suffice. A single bit *did* suffice, he decided.

One misplaced protocol bit could be passed off as an accident. More, he might be able to find that bit in the minutes he had. A glance at C-SPAN showed the quorum call was done.

This was his one chance. He had no time for other possibilities. This, or nothing.

Put in your voting disks, he wrote to the Caucus. *I'm going to derive your identity factors from them. I need to parallel-process with your computers, too, so expect a lot of activity on your machines. I might get us back on-line, if I'm fast and lucky.*

Most obeyed silently, though some wrote to wish him luck. Ang had a more pertinent observation. *They've started.*

Richard looked up again. Familiar voting tables were superimposed over a shot of the House floor. "Time Remaining" winked away the seconds at the bottom. 14:51, and counting.

He could write the needed codes almost without thinking, and did. He tied his personal computer into his work machines, and theirs, and set them to finding the common denominator in all the security protocols. That would be the time-dependent factor, the altered one. With dozens of quantum processors working on dozens of data points, the task would take minutes.

But how many?

There was a rap at the threshold. "What's all the turmoil up here?" Erica asked. "What's Jeffrey—what are *you* doing?"

Richard gave her the fifteen-second overview. "I'm trying to repair the pads. We're both trying to contact anyone who can get the vote suspended."

"Looks like you did."

Richard followed her finger. He had responses to his emails. "Can you handle those, Erica? I'm still coding. Squeeze in here."

As she worked her chair in, Jeffrey appeared. "I've got someone at CBS ready to talk to you."

"I can't go out there. Transfer him to this phone."

"Uh . . . Michelle knows the phone system. I'll . . . try."

"Should I talk to him, Richard?"

"No, stick with the news servers. Blast!" He backspaced over a string of typos. "Come on, where's that prime?" A look at C-SPAN: nine minutes.

A minute later, his computer beeped success. "Finally!" He rattled off a last line of code, then started the search. The machines would alter each bit of the time-dependent factor in turn, combine it with his identifier, and try to access CongressNet. Connection time would produce most of the waiting. If the solution were any more complex than a single altered bit, he'd never have time to fix it.

"Do you have him?" Jeffrey called.

His phone was flashing. Richard hit "picture" and "speaker." "Yes?"

"Congressperson Welles? Kent Shays, CBS. How fast can you give me a rundown of what's happening?"

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Richard blew breathlessly through the events. "Mr. Shays, it's imperative you inform the House what's happening, suspend the vote until we can be duly counted."

He could swear he heard a snicker. "Our job is to report events, sir, not affect them. We are willing to interview you on-air, get your side of things."

"Now? It's now or never."

A moment of nothing. "Okay. You've got a hard one. One minute to air."

"Fine. I'll need that minute." He put the phone on hold. "'My side of things,' he says. Why do I have a bad feeling? Erica, tell me you're doing better."

"I am. Not much, though. Two news servers are trying to contact Congress, but their email isn't getting through."

"Ugh. Trust them to know one method of communication."

C-SPAN showed six minutes. He reactivated the phone. "Still there, Kent?"

"Yeah. You'll be talking right to our anchor." Seconds later, he was.

Erica reached past him for the TV remote. CBS came up, silently. The live shot was unflattering, and the text called him "Dick," but he was on.

He gave Jim Miller the same story as before, withholding his suspicions of intent until he had all the facts out.

"Worst time possible for a computer error like this, isn't it?"

Error? Richard figured out why he had a bad feeling. "Jim, I honestly think this isn't an error. The way it locked us out, the way other communication lines were made inaccessible, does not point to chance."

"Perhaps so, but with your tattered reliability, this accusation—Mr. Welles?"

"Sorry for the shout. I just got through. Corrections are heading out to all the other Stay-at-homes. Time . . . " He clicked to C-SPAN and back. "Nearly four minutes left. I think it's enough." He leaned back, smiling wearily.

"Then your single-bit theory was correct. That definitely points away from your sabotage notion. I'm sure you're relieved."

"Jim, I'm not sure you've followed me—"

"We have to cut away now, but we'll speak to you again later. Despite this melodramatic turn, our informal caucus still shows—" Miller's voice faded out.

Richard had no time to indulge anger. *Success,* he wrote to the Caucus. *You should be able to vote, now or in seconds.* He read a few lines of thanks before remembering to vote himself.

Back on C-SPAN, the ayes had a forty-vote margin with two minutes left, but that was falling fast. He looked up individual votes from the Caucus, and found a surprise. Three expected ayes had gone the other way. *Bryce, Greenblatt, Hughes, am I seeing what I think I'm seeing?*

Yes, I switched, replied Bryce. *Why not punish them for that stunt?*

If they can do that to us, Hughes said, *they could do worse in a Remote Democracy. No thanks.*

Richard passed those comments to the full Caucus. Maybe, just maybe . . .

The seconds dwindled, as the last votes came in. "You can stop now," he told Erica, who was still typing. "We made it . . . and did we ever."

Everyone had voted: 215 for, 220 against. The timer hit all zeroes.

"Congratulations, Richard!" Erica hugged him hard and long, and Richard couldn't think of a good reason to make her stop. Unfortunately, she found one.

"Richard?" She turned him back toward the television. The vote was 216 to 219 now. "That shouldn't happen."

"Technically, no," he said leadenly. "In practice, the majority does what it pleases."

"So they just hold it until they change two more votes?" Another shift in the numbers answered her question.

Richard's eyes fastened on a clump of people along one aisle, and the woman buffeted in its center. Geraldine Horst was a veteran in the majority, but friendly with Stay-at-homes and not an automatic party-line voter. He checked her vote. 'Nay,' so far.

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There was her laptop, on her desk, shut but powered up. He reached past Erica to make a chat request, hoping she had audio cues, hoping she'd hear.

Horst was shaking her head hard, but the crowd pressed closer. Richard looked for Paxton's face, but didn't see him.

"Two can play this game," he muttered. He pulled every House address he had into a mass mailing, saying what had happened to the VCC, whom he suspected, and imploring them to vote 'nay' if they hadn't already.

The second he banged the 'enter' key, his wife groaned. "Too late."

Horst was at her desk, holding her electronic voting card. She hesitated, and a hand grabbed hers and guided the card into its slot. "Don't," Richard said, before her other hand made four taps on a keypad, then one more.

The numbers changed again, and almost as fast, a gavel cracked. "On the resolution, the ayes are two hundred eighteen, the nays are two hundred seventeen. The resolution is agreed to."

Cheers and applause reverberated through the House chamber, and the gallery above. Erica turned aside, crestfallen. Richard stared stoically forward.

"Mr. Welles, are you still there?" Richard slowly acknowledged the man on the phone. "You'll be back on the air in a few minutes."

It sounded like a command, and had similar effect. He could imagine how they'd play it if he refused. Well, he would have something to say.

Erica turned to CBS, where a reporter had David Paxton on the Capitol steps. Paxton was beaming, though his brow had a wet sheen.

"Of course Welles's allegations are ludicrous, but that's no surprise. Welles was a desperate man, and now, deservedly, a defeated man. The Homebodies fell victim to one of the natural risks of their detachment from Washington. If they can't accept the trade-offs, that's just more evidence that their risky experiment is a failure."

"Oh, Dave," Richard rumbled, "did you pick the wrong time to play that old tune."

After making sympathetic talk about Paxton's words, Tim Miller went to Richard. "You heard Mr. Paxton's analysis. What does this night say about you and the Homebodies?"

"First, it says we're more powerful than Paxton cares to admit. His party tried to silence us in order to win this vote. I stand by that. The perfect convergence of events corroborates it, and I intend to see a full investigation into the matter."

"But won't this wild—"

"Please, Mr. Miller, I'm not finished. Second, we got to see his party's other persuasive powers in action. Their handling of Representative Horst should be instructive to all students of American politics.

"Put together, I think these points show the nature of what Remote Democracy will become, if and when it becomes law. These same people will have oversight control of the computer voting process, and I foresee them using similar methods to gain their ends."

He could sense Erica behind him, framing herself perfectly into the shot. Always the professional. He continued, overriding Miller, not even speaking to him any longer.

"Tonight, with some luck, I managed to preserve the voting rights of ninety-seven Americans. Who will be there to insure those rights when the number is ninety-seven million, and more? Who will prevent manipulation, or fraud, or outright nullification?

"You've seen what can happen. The question is, what are you going to do about it?"

Miller simpered. "That question was obviously rhetorical. It isn't my place to say."

"As much yours as anyone else's, Jim. Now you will excuse me. I have work to do."

* * *

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The inquiry did come. Federal investigators began examining whether Welles had committed Federal crimes in hacking into CongressNet. Fresh ads assailed him, and his coconspirators in the Virtual Congressional Caucus.

The probe would exonerate them all . . . two days after Election Day.

The Senate received the Remote Democracy bill, passed it through committee unchanged, and put it on the floor for perfunctory debate. The debate refused to conform to expectations.

Public opinion on Remote Democracy had grown uncertain. A vigorous ad campaign, led by a beleaguered Ohio representative, kept thoughts of the VCC shutout and images of the manhandled Geraldine Horst in the public mind. Undecided numbers soared, casual supporters discovered qualms—and "safe" senators rediscovered their courage.

Debate dragged on to the date scheduled for adjournment. A cloture vote to end debate came, requiring a bare majority rather than the sixty percent of previous decades. Forty-nine of one hundred voted to close debate.

The President himself exercised Constitutional authority to keep Congress in session. After five more days of grinding debate, a second cloture vote came. Forty-eight voted in favor.

Three days later, the Senate adjourned without a vote on Remote Democracy. Its proponents in both houses had wasted a week and a half . . . which many could have used to return home and campaign for re-election.

Hotel rooms were such dreary places to end a campaign, but the candidate had to speak, and watch the election results, somewhere. Richard had thought of using the front lawn for his final rally, but the town council wouldn't permit it in a residential zone.

So he sat with Erica and Ovalenko, writing on a computer pad, occasionally raising his head for a breath. He didn't follow the television or monitor, and their attentions were more matters of form than of suspense. News outlets had stopped holding back their exit poll data years ago, after an Internet page scooped everyone on the 2006 midterms. The national results were known, except for Alaska, Hawaii, and a few tight California races, before Ohio's polls closed.

The last month had changed the face of the election. The majority would gain nothing in the House, and lose one or two Senate seats. The Stay-at-homes, after being projected to lose seats a month before, now looked to gain ten or so.

Richard Welles's own reward was forty-seven percent of the vote in his district.

Erica grimaced as eight o'clock came, and NBC conducted the formality of putting a check by the name of Jerry Pendleton, projected winner. "Just too much money," Ovalenko muttered to herself.

Erica turned to Richard, who remained blankly absorbed. "You performed some pretty remarkable feats, you know."

"Hm? Yes, I guess I did."

She laid a gentle hand on his shoulder, and watched him write. "Can I see your concession speech?"

"Sure." He pulled folded papers out of his pocket and handed them to her.

"I thought you were writing your speech. What is that?"

His fingers weakly resisted her taking the pad. She read a few lines, growing perplexed. "Richard? *You*, writing a Remote Democracy amendment?"

Ovalenko turned from the computer. "What? *Now*, of all times, you switch sides?"

Richard reclaimed his pad. "I haven't switched anything. I'm working on several reform ideas." He loosed a sigh. "*Something* has to change, for the better. You saw how close it came to changing irredeemably for the worse. If Paxton hadn't gotten greedy—well, never

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count on an opponent's continued stupidity for your future success.

"The power of communication has grown so fast, it's unbalanced the political equations. There are no adequate checks and balances, nothing to make opinion holders count more than opinion makers, nothing to temper the desire for instant gratification. This system can't handle the change . . . not without changing itself.

"I have to try to make it the best possible reform. Maybe it will be Remote Democracy, but it can't be a tool for exploitation, or a sanction for running roughshod over anyone you can outvote." He shrugged. "If I don't, someone else will—like Paxton."

Erica nodded. "Private citizens don't get to propose amendments. I suppose you'll be trying to take your old job back in two years."

"No. I'm looking at the Senate."

"The Senate? But Paxton's—" Ovalenko's mouth made an "O." "Why, you don't let up, do you?"

"No." He turned toward Erica. "I hope your book gets a big advance. We're going to need the money."

"If you shake things up too much, I'll have to rewrite it." She kissed him effusively. "Did I marry the bravest man alive?"

"I will neither confirm nor deny." He stood, and helped his wife up. "Time to go downstairs, and tell everyone the fight's not finished."□

IN TIMES TO COME

Back in February 1998, Bud Sparhawk told a tale here of an unlikely team, Haley Surra and an engineer named Taylor, in an unlikely race down Olympus Mons, on Mars. Our yearly poll said you liked it, and I think you'll like next month's sequel, too. "Olympus Mons" ended with Taylor trying to entice Haley to join him in a prospecting venture on Jupiter's closest moon, Io. She wasn't exactly enthusiastic (". . . you want me to come out . . . in the middle of all that radiation, the volcanoes, the ice, and especially the poisonous atmosphere . . ."), but in "The Debt," they're there. It's everything she imagined it would be, which makes for a dramatic story by Sparhawk and a dramatic cover by Bob Eggleton.

The May *Analog* will also feature "Agape Among the Robots," another story inspired by an Alan Clark painting and deftly told by Allen Steele; and "Sheena 5," an unusual tale of Earth-kind's future in space, by Stephen Baxter, the well-known novelist who handily won our readers' poll with his one previous short story here. And M. Todd Washington offers us a closer factual look at "Genes, Genomes, and Genome Projects," which are very much in the biological news these days and promise to become even more so.

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THE REFERENCE LIBRARY Tom Easton

Precursor, C. J. Cherryh, DAW, $23.95, 436 pp. (ISBN: 0-88677-836-0).

End of Days, Dennis Danvers, Avon, $16, 372 pp. (ISBN: 0-380-97448-7).

The Man of Maybe Half-a-Dozen Faces, Ray Vukcevich, St. Martin's, $22.95, 256 pp. (ISBN: 0-312-24652-8).

Pangaea—Book I: Imperium without End, Lisa Mason, Bantam, $6.50, 391 pp. (ISBN: 0-553-57571-6).

Echoes in Time, Andre Norton and Sherwood Smith, TOR, $23.95, 320 pp. (ISBN: 0-312-85921-X).

The Veiled Web, Catherine Asaro, Bantam, $5.99, 357 pp. (ISBN: 0-553-58151-1).

Perpetuity Blues, Neil Barrett, Jr., Golden Gryphon Press (3002 Perkins Road, Urbana, IL 61802, 217-384-4205), $21.95, 256 pp. (ISBN: 0-9655901-4-3).

Stop Me Before I Do It Again! Darrell Schweitzer, Zadok Allen (Darrell Schweitzer, 6644 Rutland St., Philadelphia, PA 19149-2128), $4, 30 pp. (ISBN: none).

Limericks for the Midnight Hours, W. Paul Ganley, Zadok Allen (Darrell Schweitzer, 6644 Rutland St., Philadelphia, PA 19149-2128), $4, 30 pp. (ISBN: none).

C. J. Cherryh's **Precursor** picks up where the "Foreigner" trilogy ended. Here's the background: A starship laden with the builders and residents of a planned Station met disaster. Lost in space, they found a hospitable star and built a Station in orbit above a world whose humanoid natives, the atevi, had a technology roughly equivalent to nineteenth-century Europe or America. The ship and its crew then departed to seek a way back to Earth's homely environs, while the misplaced Stationers landed, built a colony, interacted with the atevi, blundered mightily, fought a disastrous war, and wound up confined to a single island, with a single official, the paidhi, one of the few humans capable of understanding atevi psychology, in charge of a measured transfer of human technology to the atevi, who tend to catch on very rapidly.

Two centuries later, the paidhi was Bren Cameron. The earlier trilogy showed us his world of politics and schemes, taught us to like the atevi rather better than many of the humans on the island, and roused our anxieties on their behalf when the ship came back at last, battered and worn and bearing frightening news of inimical aliens who just may be following them.

Since neither the humans nor the atevi on the planet had the ability to reach orbit, and since the ship carried no shuttles, the ship dropped two of its crew by capsule and parachute. They were to become paidhiin themselves, translators and mediators, and conveyors of the ship's technology to both groups on the ground.

Now the atevi have a space shuttle ready and are on the verge of being able to go up in force to rebuild the station and repair and refuel the ship. The human faction that sees the situation as a gods-given opportunity to seize the planet from its rightful owners has been quelled for the moment, and Bren Cameron is returning from a well-deserved vacation with his family. Things are a bit tense, for the ship humans have recalled their emissaries and the atevi

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leader—who has a tendency to let opponents choke themselves on their greed ("Want a little? Have the whole pot!")—has answered an island request for a shuttle ride for four emissaries with an immediate ticket ("We launch tomorrow—be there"). And when the plane lands, Bren discovers that he too is going up on the shuttle, along with his personal security squad, his domestic staff, and his alien lover.

Bren's life is never boring. Up they go. They get settled in. They meet with a pair of ship captains, Ramirez and Ogun, and the negotiations seem to go very well. But then everything slows down. Meetings are postponed. Rumor hints that Ramirez has been shot, is dead, is in hiding. Hard-line human chauvinists who don't want aliens on *their* ship or station—no matter that the human islanders don't have the capability to do the necessary work—seem to be in the ascendant. And Bren must use every skill he has acquired in political intrigue to turn things around.

He succeeds, with the aid of a surprising ally, and the reader hands Cherryh one more of her usual rounds of applause. The reader will also be eager for the next volumes, *Defender* and *Explorer*, whose titles suggest an encounter with the new aliens, so far safely offstage, and then a renewed search for Earth.

Some time ago, Dennis Danvers posited a drastic change in the conditions of most human lives. In *Circuit of Heaven*, most of Earth's populace uploaded into the orbiting Bin, a massive hypercomputer simulation of Earth, in which everyone could go on forever with the very best standard of living possible. Those who did not upload were predominantly religious crazies such as Gabriel and his army of Christian Soldiers, who believe the Second Coming awaits only the utter extermination of all unbelievers. They attacked the Bin with computer viruses and thought they had won when all lines of communication went silent. They then proceeded to nuke every cluster of humans they could spot with satellite surveillance, with the notable exception of the Constructs, descendants of clones genetically engineered to have various nonhuman features and thus be sufficiently nonhuman to be property. Their owners are gone now, and they have settled right on the outskirts of Gabriel's New Jerusalem, a bit close for nuking.

The sequel, End of Days, is set some seventy years later. The Bin is still there, of course, and one of its residents is Donovan Carroll, a "newbie" born in virtuality, never having known flesh. He is convinced that humanity gave up something crucial when it gave up mortality; death must be brought back into the picture. Most folks think he's nuts, but the fact is that most folks are pretty bored and unmotivated. (Me, I think what they lack isn't death, but limits on their self-indulgences; there's nothing like a bit of privation and competition to motivate.)

On Earth, a Christian Soldier named Sam has just found a mysterious installation, electronic, active, and containing the uploaded essence of a single human being, the very Walter Tillman who once invented the cloning process that produced the Constructs, fell in love with Stephanie, super-model trophy wife of his tycoon boss, and watched said boss scheme to clone wifie into a horde of sex slaves. Walter is obsessed with his memories of Stephanie. Did she truly love him? Did she betray him to the men who shot him?

Stephanie, of course, is in the Bin, quite unsatisfied with her life. She finds Donovan Carroll, Dr. Death, thinks he might be right, and asks him—since the operating system allows people to commit suicide only when they really mean it—to arrange a way for her to download into a human body down on Earth.

Sam has his doubts about Gabriel (who's still around, a century and a half

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old) and the Second Coming, so he listens to Walter and winds up promising to help find a way to get him out of his box and into a body. Soon enough he's involved with Laura, descendant of a Stephanie-clone, who in turn talks with the folks upstairs in the Bin, including a friend of Dr. Death. Meanwhile, Gabriel has winded Tillman's home, which has a record of the launch codes for all the missiles that remain on Earth; if he can get those codes, he'll destroy the Bin for sure. Fortunately, there are a great many copies of the Bin, with all its residents, heading for the stars. No matter what happens, we'll go on, multiply.

Laura meets Stephanie meets Tillman meets Sam meets. . . . The head spins, but it's a grand romantic yarn with a perfect finish. Enjoy it, and watch for the Danvers name in future.

Skylight Howells, the private-eye hero of Ray Vukcevich's **The Man of Maybe Half-a-Dozen Faces**, is so addicted to tap-dancing that he periodically disappears into dance halls, only to surface a day or two later dazed and broken. He's in a Twelve Step Program, but you know how those work; wagons are for falling off of (and calling the program "Twelve Step" just reminds the addict of what he's trying to avoid). He is also really into disguises. Or maybe he's got Multiple Personality Disorder, though it seems more like role-playing. Whatever, when a doll who looks "like something I'd made up myself" waltzes into his office to wail that her twin brother Pablo is on the lam for a murder he didn't commit and to offer him a math quiz to see if he has enough on the ball, he rips off his mustache, puts on his glasses, and turns into Dennis the Math Guy. Now the best he can say about the doll is, "Nice teeth." The math, of course, is now easy.

The victim—strangled with a printer cable—and Pablo cowrote a computer manual. Soon more victims turn up, the common feature seems to be that they all wrote computer documentation, and the killer leaves clues that suggest he is seriously annoyed at documentation that omits such crucial details as how to get out of a computer program. Sky and his alter ego Dieter the Mexican food chef (who has been sparring for years with the SSOMFC [the Secret Society Of Mexican Food Cooks] over the true identity of the secret ingredient that makes real Mexican food taste great) pick up some clues online. Scarface sneaks into the crime scene and gets clobbered by a mysterious stranger. Tag (The Average Guy) eludes police pursuit. Lulu works on another case.

And the bodies and clues accumulate, until in due time everything comes together in a reasonably satisfying way.

Vukcevich is having a high old time with this one. There isn't a serious bone in the entire corpus of his intentions. Sky-Dennis-Tag-Lulu-etc. is about as over-the-top as you can get, and the motivating crime is the sort of nonsense that one can mutter when properly aggravated by the world's shortcomings but never act out. But Vukcevich does it all well. One can almost believe in Skylight Howells and his problems, and one entirely enjoys the romp.

Have fun!

Lisa Mason has shown herself to be a thoughtful, talented writer with several excellent novels (*Arachne,* reviewed here in December 1990; *Summer of Love*, January 1995; *Cyberweb*, August 1995; and *The Golden Nineties*, May 1996). You therefore hardly need to be told that when you spot **Pangaea—Book I: Imperium without End** on the bookstore shelf, you should give it at least a look.

The original Pan was a god of nature, given to music not of the sort that stirs the soul to dance. Anti-pagan latecomers to Europe associated him with terror and chaos. A god of movement, then, to be associated quite fittingly with earthquakes and upheavals.

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Mason's Pan is a more ethereal god, or so believe her tale's people, organized into castes or "purities" valued according to their presumed closeness to Pan. The closest caste is the angels, some of whom dream visions of pannish love, pure and nonphysical, for the nightly edification of the masses (other angels' dreams are more adventurous). Reproduction is straight out of *Brave New World*, a matter of preserved eggs and sperm united in holy glassware and grown in artificial wombs after suitable genetic tinkering. Sexual passion is supposedly a thing of the ancient, primitive past, but even angels indulge with the aid of professional "eroticians." The lower classes, of course, are less noble, and it is worth noting that Mason hints that closeness to Pan is subject to redefinition. Passion cannot be suppressed forever, and perhaps the low will become high before the end of this series.

Pan is also the Pan of Pangaea, the term for the single huge land mass that dominated the Earth's geography many millions of years ago. That is also the configuration of Mason's Earth, which tells us that the time of her tale is in the very distant future. Accordingly, there are drastic changes in the planet's biota—domestic animals, for instance, seem to have been replaced by gengineered strains of humans—and place names (a few of which hint that the story is set in a much altered version of Mason's California). There are also remnants of ancient technology, still working but not understood or repairable or reproducible at all.

A rigidly stratified society dominated by esthetes whose primary interest is keeping themselves at the top of the heap, maintaining the status quo, imperium without end, amen. And right from the start, Mason is saying, "Imperium without end? Endless status quo? Yeah, right! Gimme a break!"

Okay. A break: Here is a crew of academe (university) researchers in a chamber deep within the crust, studying a fault, preparing to play music (creating harmony) to prevent a "bounce" that might do damage aboveground. Much to their astonishment, the fault pops and one of the crew, Plaia, swears she sees it move, not bounce. When she insists, she herself is bounced out of her academe position. The powers that be are thoroughly wedded to the idea that the Earth's surface moves only up and down, not sideways (a century ago, our own forebears thought the same; continental drift and plate tectonics were generally accepted only in the 1960s). They have no faint idea that Pangaea exists because of change. Efforts to stop change—as by pumping seawater into fault zones—are even likely to backfire.

The same is of course true on the social level. Mason begins her tale here, with the news that the angel Milady Danti, most beloved of all women in the Imperium, has been viciously assassinated. Lucyd Sol, her sacred sharer (their minds are linked or shared by implanted chips similar to those that permit receipt of broadcast dreams), is in mourning, but he bravely tries to carry on with his task of dreaming of pannish love for the masses. Unfortunately, his dream is invaded by images of a terrorist and the Orb of Eternity, a banned device used to generate oracles.

Then comes the earthquake and devastation of the city. The ensuing chaos embroils among others Regim Deuceman, a cop or magister, Tahliq, his favorite erotician, and Dubban, a midwife of the natalries (where the birth tanks are operated). The tensions that threaten this society become clear, and we can see its fall coming.

This one works enticingly on many levels. Don't miss it, and watch for its sequels.

André Norton's *The Time Traders* appeared over forty years ago. Time travel was invented, and the US-Soviet Cold War moved into the past. In the sequels, *Galactic Derelict*, *Defiant Agents*, and

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Key Out of Time, derelict starships were discovered, with an ensuing jaunt around the galaxy, an encounter with inimical "Baldies," exploration, and even colonization. Rousing adventure, great fun, and fond memories.

It is thus no surprise to see the series revived with **Echoes in Time**. The Cold War is over, and technology has changed in forty years. Norton and Smith give a nod to the former and ignore the latter by using laptops as if Norton knew about them all along. Then they get on with the tale: A Russian exploration team has vanished in the past of a world we first saw in *Galactic Derelict*. Then it was marked by an abandoned spaceport, savage weasel-like creatures, and flying humanoids. In the past the weasels are a civilized people, the Yilayil, and the city is occupied by a host of other species. The Russians provided language tapes and other data before they vanished, and now newlyweds Ross Murdock and Eveleen Riorden, Gordon Ashe, and African ethnomusicologist Saba Mariam, together with another Russian team, must infiltrate the Yilayil culture, try to find and retrieve the missing, and—thanks to Saba's gift for music—unravel the secrets of a world.

It's an interesting puzzle, and the authors are ingenious enough in their depictions of alien ways to make the tale a pleasure to read. Surely it will send new readers in search of the original Norton books.

But it does not—perhaps it cannot—satisfy entirely those of us who remember the originals when they were new and we were young. In her heyday, Norton was strong on momentum; her stories moved relentlessly forward, and though she was good at depicting mood and atmosphere, those did not dominate. In *Echoes in Time*, the balance has shifted enough to make the flavor very different. The flavor is also affected by forty years of shifts in the general style of science fiction; there is a greater awareness of romantic factors, and styles are generally more subtle.

We shouldn't be surprised at such things. But like the abrupt jump in the technology available to the characters, they do make it a little difficult to accept *Echoes in Time* as an actual continuation of the old series. The discontinuities can be too striking.

Physicist, ballerina, and SF writer Catherine Asaro has shown a taste for romance in many of her novels. In her successful *The Last Hawk*, for instance, she turned a number of romantic traditions on their heads while remaining true to the SF form.

The Veiled Web is definitely SF romance, with those romantic traditions right side up. The protagonist is Lucia del Mar, a young prima ballerina who never completed high school but still gives the impression of being at least a grad student in computer sciences. Granted that Lucia is a Web junkie, I still found that a bit difficult to accept; but what the heck—if Catherine can be all she is, so can her characters.

After a stellar performance, there is a White House reception. There she meets Moroccan Rashid al-Jazari, a beautiful businessman, and is smitten. Alas, receptions are seas where ships pass in the night. But now she's in Spain, sitting at a café table, and there he is again! They go for a drive, and his chauffeur proves to be a villainous traitor. They are kidnapped, taken aboard an airplane, and once they subdue their captors, they must land (a bit bumpily) in a country where no one wants to let them go. Muzzy from drugs and fatigue, she agrees—not really knowing what she's doing—to marry Rashid. Now they can leave.

Lucia is an independent, modern, career woman. Rashid is a Moslem whose family still believes that women should live in seclusion and wear the veil in public. Nice guy and all that, but a bit of a shock to Lucia, and what has she done to herself?

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Rashid turns out to be not just a businessman, but a computer wizard bent on using artificial intelligence to turn the Web into a bridge between cultures and people, a place where differences merge and are accepted. But he himself is not able to compromise, and his creation is hamstrung by the same problem. Lucia works with it and helps a bit, but she cannot do enough before their mutual and powerful attraction founders on Rashid's rigidity.

Meanwhile, the kidnappers are still out there, and they have designs on Rashid and his creation. Rashid and Lucia aren't through the fire yet. Since the romance traditions are all right side up here, you know they'll come through and find some way to be together, but that's all I'll give away.

If you like romances, or if you think there's no way anyone could blend them with SF, grab this one. Asaro has done another very nice job.

Briefly noted: Golden Gryphon Press has released **Perpetuity Blues**, a collection of Neil Barrett's short fiction. You may remember "Ginny Sweethips' Flying Circus." Barrett is a prolific and interesting writer whose work regularly makes "Best of the Year" collections and is often nominated for the Nebula and Hugo awards. He surely deserves more attention than he has received.

Darrell Schweitzer has committed another chapbook of eldritch rhymes, including "Eldritch Gifts, a Hymn," which begins, "It's a gift to be squamous, it's a gift to have fins...." Nor should I forget to mention "Necrophilia for Beginners." If you can stomach such stuff, send him four bucks and he'll send you a copy of **Stop Me Before I Do It Again!**

For another four bucks, he'll send you **Limericks for the Midnight Hours**, by W. Paul Ganley, who spent thirty years as the editor and publisher of *Weirdbook* and is a demonstrably witty and clever fellow. Among the items that made me smile is his "Manx Limerick":

Writing poems can mean sweating blood—
But limericks pour out like a flood!
I wonder if prose
Is as easy as those?

(If you can't figure out what makes that a "Manx" limerick, he tells you.)□

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BRASS TACKS

Dear Mr. Schmidt:

Regarding your recent editorial, "Technological Temptation," in the November 1999 issue—

Actually, the situation you describe as hypothetical exists now in many work places, public areas, and one entire (albeit tiny) country. When my sister worked in Monaco some years ago, every public space and building was monitored by cameras. She says it was the most crime-free place she'd ever lived, and the only time in her life she felt safe walking alone wherever and whenever she wanted, even at night.

In my own imaginary L-5 colony, designed by a woman engineer and lawyer (now that's schizophrenia for you), there are, similarly, video cameras covering all public areas and buildings: the tape is stored for a year and viewed upon the filing of a related crime report.

Yes, there would be a reduction in privacy in such a scheme. But privacy is a rather new and modern concept, related to urbanization. For the first some 95 percent of human history, almost all humans lived in small hunter-gatherer bands or small villages, where everyone knew everyone else and privacy was neither possible nor especially desirable. Being by yourself meant a good chance of becoming lion food. Being surrounded by strangers meant a good chance of being killed by them. Those close-knit societies had their own pressures of conformity and lack of freedom, but they also had advantages. I think it was Colin Turnbull in *The Forest People* who noticed that the African pygmies he lived with experienced almost no wife beating, not because marriages were less contentious or men less violent, but because when you lived in a leaf-covered hut three feet from all your relatives and in-laws, the sound of raised voices or of a fist hitting flesh was a signal for people to come in and break it up. The anonymity of living in a city, surrounded by strangers, unnoticed by the crowd, can be a liberating experience for a strong and healthy adult. It's also a bonanza for a predator.

The precipitating event for this letter was an email I received a few days after reading your editorial. The email purports to be (and may actually be; it doesn't really matter) from a state correctional officer, giving a list of common sense suggestions on how women can avoid becoming victims to sexual predators. I read the list over, nodded thoughtfully, made some effort to memorize the suggestions that were new to me, and forwarded the list to female friends.

And I wondered: How much time and effort have you spent in your life avoiding becoming prey? Yes, privacy has benefits, but it also has costs, and those costs fall disproportionately upon women, the very old, the very young, the poor, minorities, and the physically or otherwise handicapped (a good deal more than half the population, you may notice). The benefits of privacy, in fact, may be most apparent to healthy adult white males and criminals. You may argue, and rightfully, that males are also victims of crime, but when was the last time you modified your behavior for fear of rape?

Crime can be as much a deterrent on

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individual freedom as the loss of privacy can be a deterrent to crime, as you pointed out. But not everyone pays the same costs, and I'm not sure how much of your freedom I can afford.

Eileen Roy
Fullerton, CA

Stanley Schmidt,

Normally one of the first and most enjoyable things I read is your editorial. Your thoughtful and insightful comments often give me much to think about. However, you sure missed the boat in the November 1999 issue. You took a controversial subject that is sure to require careful thought in the coming years and responded with a black and white straw man. A counter-example, along the same vein would be that since observing someone may limit their freedom, no police may walk or drive around on their beat. After all, many officers have TV cameras recording all interactions they have when a car is pulled over.

I want to make clear that I'm not disagreeing with your conclusion. I haven't made my own mind up with regards to this matter. For this reason, and because this subject is so important (and because I respect the insights that you generally add to a discussion), I hope you'll go back and try again; but this time leave the straw man out and discuss the places to draw the line in this very gray area.

L. M. Jennings

Please look again—I did not *say or imply that cameras should* never *be used, or that if we used some we would necessarily proceed down a "slippery slope" to using them everywhere possible, or that there was no way of turning back if we started down such a path and changed our minds. What I* did *do was take a direct quote from somebody who claimed to believe that "*Anything *that will deter crime . . . will be beneficial," take him at his word, and extrapolate his premise to its logical—and, I hope, disturbing—conclusion.*

Dr. Schmidt,

I am disturbed, not at what you wrote, but with the conditions that caused you to write "Technological Temptations." Surveillance cameras are a violation of due process, in my opinion. Particularly, the retention of the tapes even if no criminal acts were recorded. It flies in the face of the tenet of innocent until proven guilty. It appears that the assumption is that anyone photographed is a potential criminal. The same could be said of those in a house of worship, classroom, theater, or buying groceries at the supermarket. I realize that the nominal target is drug dealers, but like the camel with its nose under the tent flap, this could grow to the proportions that you suggest.

True we used to do "stake-outs" and sometimes used cameras. But we were concerned with a particular activity and/or specific individuals. It wasn't the broad spectrum witch hunt of the surveillance cameras.

Secondly, I thought parks were places people could go for relaxation and recreation. Climbing trees is a natural challenge to youngsters. I know of many trees that have seen several generations of kids climbing in them without damage. I suspect the prohibition against climbing is more to protect the city from being sued if a child is hurt than to protect the tree. In any case, I believe it is a gross abuse of police powers.

Lastly, I was somewhat amused at your suggestion of having a beat cop exercise a little "curbstone justice." This was the norm before automobiles and two-way radios. The old flat-footed Harness Bull was the epitome of good policing, as he knew all the denizens on his beat and they knew him. This made for a greater rapport and more effective policing. The technological move to automobiles and radios in the name of efficiency isolated the police officer from his peo-

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ple and vice versa. Neighborhood Policing, Storefront Stations and other such programs are a move back towards the old philosophy of policing, but they do not have the bean-counter administrators' backing except as sops to a largely uninformed and uninterested public, and as budget multipliers. "Crime fighting" and "Crime prevention" are jokes, mere smoke screens to appease a public and convince governing bodies that bigger budgets are needed.

I first became a law enforcement officer in 1949, all bright-eyed and bushy-tailed and ready to eliminate crime. When I retired in 1973, I had removed a lot of bad characters from the streets. But, for every one I removed, a replacement was already busy. A community will have the types and levels of crime it will tolerate. Citizen programs such as Neighborhood Watch and Take Back Our Streets are far more effective than all the new "innovative" police programs. Citizens being responsible and involved is the best weapon we have for abating criminal activity. You see something wrong, call the cops and demand a timely response.

JIM WALTON
Huachuca City, AZ

Dear Stan:

In regard to Stephen Gillett's Science Fact article in the November '99 issue: In the first place, while I don't like to be a naysayer, I strongly suspect that "carba" cannot be synthesized. My reasons for this suspicion are partly theoretical, partly empirical. The empirical reason is a relatively straightforward one: I'm a chemist by training, and generalized structures such as those "carba" represents would be well-known to the chemical community if they were commonplace, or even existed. Furthermore, there are dozens, if not hundreds, of chemists in both academia and industry, who make their living (and their reputation) just by synthesizing novel, obscure, and unexpected compounds. Because of this I find it inconceivable that nobody has tried. While I have not done a literature search on the subject, I would not be surprised to find that there does in fact exist at least one report of somebody attempting and failing to synthesize this compound.

My theoretical reason for suspecting that it cannot be made lies in the general properties of carbon and oxygen. The carbon=carbon bond is stronger than that of carbon to oxygen; that's why carbon forms the long chains characteristic of organic materials in the first place. Oxygen dislikes being part of linear structure—in its compounds it assumes a bent configuration (measuring the angle of the bonds between the oxygen and its two adjacent atoms). Thus, forcing it into a linear arrangement is energetically unfavorable. Combining these properties of the two elements leads one to conclude that if "carba" were indeed formed, it would spontaneously disproportionate back into CO_2, which is energetically favored.

However, the initial thesis of the article is centered on the issue of terraforming Venus. Considering the basic chemistry of the situation, there is another approach, one that does not involve exotic and unknown materials, one for which the chemistry is known and very simple, and one that solves two of the problems brought out by Dr. Gillett, not just the removal of CO_2 from the atmosphere.

Dr. Gillett dismisses the idea of using cyanobacteria to create oxygen from the CO_2 with what I tend to agree is the likely scenario of creating a chemical cycle that would return the CO_2 to the atmosphere. However, that cycle is easily broken. The solution to the problem lies not in trying to export the excess carbon, but in importing hydrogen. If elemental hydrogen were brought to Venus and dispersed (easily done simply by releasing it into the atmosphere) it would react with the oxygen generated by the cyanobacteria to form water—the other

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major material that we will find desirable in a terraformed planet.

Under the catalytic influence of UV radiation from the Sun the reaction would proceed while the hydrogen is at low enough concentration not to "explode" as some might fear, and is so energetically favored that the reaction will go to completion—note that there is no free hydrogen in the Earth's atmosphere; and that is the reason: it all reacts.

Thus we accomplish the dual goals of removing CO_2, and creating water. At the same time, since hydrogen is the lightest element, less mass has to be transported than if we were to move any other material, to bring a stoichiometric amount to the planet.

HOWARD MARK

The author replies:

(a) Since I wrote the article, carba (as the quartzlike polymorph) *has* been synthesized, under high pressure in a diamond-anvil cell (Iota et al., *Science,* v. 283, p. 1510, 1999). Those authors were not able to quench it to STP, so it may be, as Dr. Mark suggests, that the energetic barriers to its rearrangement are too small for the phase to be metastable. However, these authors' carba would have an extremely large surface energy and is probably also riddled with crystalline defects, both of which will tend to drastically lower energy barriers to reaction. We'll just have to see once macroscopic quantities are made. Recent detailed molecular modeling (Serra et al., *Science,* v. 284, p. 788, 1999) suggests the carba structure should be metastable.

(b) His implication that "surely someone would have thought of it already" is most unconvincing. I am fully aware that there are lots of chemists out there trying to make new compounds—I *work* with some of them! Nonetheless, people still keep managing to come up with new compounds. I also have more than a nodding acquaintance with the chemical literature, and it is surprising the number of "obvious" compounds that hadn't been synthesized until very recently indeed. For example, a new polymorph of titanium dioxide—TiO_2(B)—wasn't even *made* until the 1980s, and has since been discovered in nature! (Banfield et al., *American Mineralogist,* v. 76, pp. 343-353, 1991) Of course, TiO_2 is a compound that's been known for some time.

(c) His point about a linear C-O-C bond being energetically disfavored is irrelevant. A linear Si-O-Si bond is also disfavored; this does not keep Si-O-Si bonds from being extremely abundant in silicates and related compounds such as siloxanes ("silicones"). In fact, the favored angle for Si-O-Si is ~140 degrees, and to accommodate this, the links between the SiO_4 tetrahedra simply bend.

Indeed, none of the SiO_2 polymorphs has linear Si-O-Si bonds at STP. In "low cristobalite," the room-temperature analog of "diamond ether," the oxygens do not lie directly between the silicons but are offset. This is, of course, the sort of detail that's not appropriate at the level of an *Analog* article.

(d) His notion about importing hydrogen as the "oxygen sink" is not new. This idea was discussed in Jim Oberg's seminal book *New Earths* nearly 20 years ago (Stackpole, 1981), and I touched on it in my previous articles (December 1984 and mid-December 1989 in particular). However, if you calculate how much H_2 you need to import, you find that this is not an "easy" solution at all, especially given the problems with transporting planetarily relevant amounts of gas across the Solar System. Moreover, the advantages of hydrogen's low mass are offset by its low density and extremely low boiling point, which makes vessels to hold it both bulky and expensive. (These disadvantages, of course, are well known to rocket designers.) In fact, I'd originally suggested slinging in ingots from Mercury because transporting hydrogen is such a hard problem!

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Furthermore, converting a major fraction of Venus's CO_2 into water has problems of its own, because you end up with too much water. This makes it difficult to avoid triggering a new runaway greenhouse, as H_2O vapor is an excellent greenhouse gas. I also mentioned this issue in 1984, and later discussed it further in a more technical paper (*J. Brit. Interplan. Soc.*, v. 44, pp. 151-156, 1991).

STEVE GILLETT

Dear Stan,

I enjoyed Stephen Gillett's "Diamond Ether, Nanotechnology—and Venus" science fact article.

There's more than one way to skin the Cytherean cat.

I think that I may have two novel approaches that address the carbon flammability issue.

A brute force method would be to allow the maximum thickness (as limited by auto-ignition oxygen concentration) of carbon film to build up on the surface. This layer could then be mixed and heated with crustal silica by using large quantities of "clean" thermonuclear charges. This would form practically inert silicon carbide, and release additional oxygen.

A more elegant, and even more visually dramatic method would be to seed the Cytherean (Asimov was right, it does sound better than "Venereal") atmosphere with two flavors of microorganism. One produces oxygen gas, the other produces a flammable gas such as hydrogen, methane, or even alcohol. Over time the concentrations of these gases will build up throughout the atmosphere. At some point the concentrations and partial pressures will fall between the lower and upper explosion limits. The next lightning bolt would turn the entire atmosphere into an expanding ball of flame. This is a fuel air explosive, or FAE.

Military FAEs use a few tens of kilograms of fuel and pack enough energy to be called a poor man's nuke. A planet-wide FAE could easily blast anywhere from 10 to 50 percent of the atmosphere into space. It would be a spectacular show! Venus might even briefly outshine the sun as seen from earth.

The remaining atmosphere could then be reseeded and the process repeated as needed to drop the pressure to acceptable levels.

But before we start, let's make darn sure that there is no native life . . .

DEAN HOPKINS, JR.
San Jose, CA
hopkinsdjr@aol.com

Dear *Analog*,

Regarding Jeff Shenk's letter about the use of a flexible, "wetsuit" design for spacesuits ["Brass Tacks," November 1999], I can think of one technical reason that the wetsuit design hasn't caught on. In the water the pressure is outside the suit, pushing it in against the wearer's skin. In space the pressure would be inside the suit, holding it away from the wearer and tending to "balloon" it.

You don't hear much about it these days, but in my youth I read more than one story about the deep-sea hard-hat diver whose air escape valve jammed shut and, as a result, he "blew up." That is, his suit filled with air under pressure, its legs and sleeves ballooned and stiffened so that he could not move, and his added buoyancy propelled him to the surface—where his handlers had to work fast to get him into a compression chamber to save him from the "bends."

You can alleviate this unfortunate tendency somewhat by adding constrictions at the shoulders, elbows, wrists, hips, knees, etc., so that the ballooning takes place between those joints. But by the time you've done that, you're most of the way to the "spacesuit" as we now know it.

CHARLES CHANDLER
Lexington, MA■

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UPCOMING EVENTS Anthony Lewis

31 March–2 April 2000
5CON (5-college area SF conference) at Seelye Hall, Smith College, Northampton, MA. Registration—$15 until 15 February 2000; $25 at the door; Friday 5 P.M.–9 P.M.: $10; Saturday 9 A.M.–1 A.M.: $15; Sunday 9 A.M.–4 P.M.: $10. Info—5CON, 98 Green St. Box 8758, Northampton, MA 01063. email—<viktorie@javanet.com> URL—<http://sophia.smith.edu/ssffs/5con>

20–23 April 2000
IMAGINE CON 2000 (Tidewater area SF conference) at Virginia Beach Pavilion, Virginia Beach, VA. Info—Imagine Con, 1118 Willow Road, Chesapeake, VA 23325; (757) 424-1853. email—<info@imaginecon.com>

20–23 April 2000
NORWESCON 23 (Seattle area SF conference) at SeaTac Doubletree Hotel, Tacoma, WA. Artist Guest of Honor—Bernie Wrightson. Fan Guests of Honor—John & Bjo Trimble. Info—Norwescon 23, Box 68547, Seattle, WA 98168; (206) 270-7850. email—<info@norwescon.org>; url—<http://www.norwescon.org>

21–23 April 2000
BALTICON 34 (Baltimore area SF conference) at Omni Inner Harbor Hotel, Baltimore, MD. Guest of Honor—Octavia Butler. Artist Guest of Honor—Wendy Pini. Editor Guest of Honor—Richard Pini. Fan Artist Guest of Honor—Stephen Stiles. Registration—$40 until 31 March 2000, $45 at the door. Info—Balticon 34, Box 686,Baltimore, MD 21203; (410) 563-2737. email—<bsfs@balticon.org>; URL—<http://www.balticon.org>

21–23 April 2000
MINICON 35 (Minneapolis area SF conference) at Minneapolis Hilton & Towers, Minneapolis, MN. Guest of Honor—Maureen F. McHugh. Artist Guest of Honor—John Berkey. Fan Guest of Honor—Lenny Bailes. Info—Minicon 35, Box 8297, Lake St. Stn., Minneapolis, MN 55408.

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31 August–4 September 2000
CHICON 2000 (58th World Science Fiction Convention) at Hyatt Regency, Chicago, IL. Guests of Honor—Ben Bova (former editor of *Analog*), Bob Eggleton, Jim Baen, Bob & Ann Passovoy, TM—Harry Turtledove. Registration—$150; supporting $40. [These rates are good as of 1 October 1999; they may go up again. These are the latest posted rates as of the time this column went to press.] This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info—Chicon 2000, Box 642057, Chicago, IL 60664. email—<info@chicon.org> URL—<http://www.chicon.org/>

26–29 October 2000
WORLD FANTASY CONVENTION 26 at Omni Bayfront, Corpus Christi, TX. Guests of Honor—K. W. Jeter, John Crowley; TM—Joe Lansdale. Info: WFC 2000, Box 27277, Austin, TX 78755. email—<fduartejr@aol.com>■

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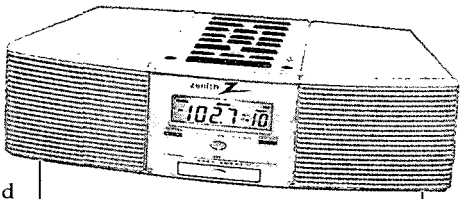

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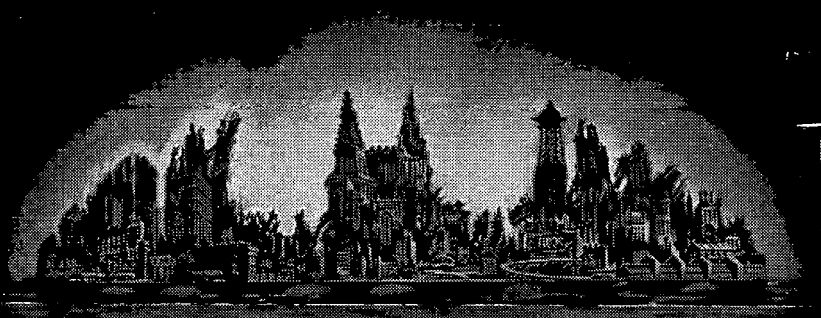

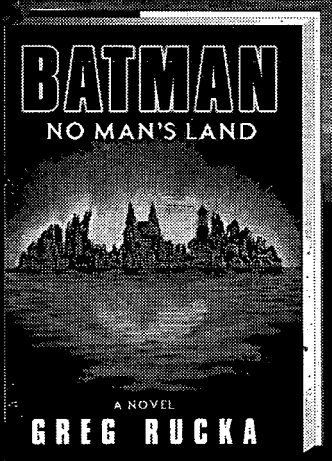

Leveled by a massive earthquake, Gotham City has been completely cut off from outside aid, transformed into a lawless battleground—a No Man's Land. In the midst of the chaos, dedicated Police Commissioner James Gordon and Batman must overcome their differences to reclaim the city.

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